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Published at the World's Greatest Railway Center
Established 1878

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Nothing stands still. Each of us is either going forward or backward. We see examples of this all about us, for nature itself is constantly building up or tearing down, sometimes slowly but always surely. A locomotive in active operation out on the line is constantly depreciating in value and efficiency, and if it is standing boarded up on a siding the depreciation is perhaps still greater. A trip to the shop where it is given a complete inspection and repaired, again appreciates its value.

On the first of the year we start on another trip around the circle. It is a good time to take a complete inventory of ourselves, to balance up the books, to see what we have gained and what we have lost. Have we gone forward or backward? If we can't show that we have gone forward it is a safe bet we have slid back a notch. How about it—has the work over which you have had charge during the past year been done better and more efficiently than ever before—do you know that you are a bigger man than you were in January, 1911? Nothing stands still.

CAR VENTILATION.

Fresh air is a subject in which the American people are greatly interested nowadays. Nearly every one is a fresh air fiend or thinks he is. Cities are fighting against undue pollution of their air, and a great deal of attention is being paid to the ventilation of schools and other buildings. Coupling to this the fact that we are traveling more and more each year, it seems that the ventilation of the passenger car has not kept pace with the demands upon it. The ventilation of the average railway coach until recently has been no better than it was thirty years ago. It is true that ventilation is a subject of which we do not know a great deal at present, but we have not even applied what we do know to the passenger car. We do have ventilation for removing bad air from the car, which of course means that fresh air takes its place, but the difficulty is in heating and introducing this air at the proper place. Heating and ventilation are one subject; the two must go hand in hand and not separately.

The general way of introducing cold air through windows, doors and deck sashes is not in accord with the principles of ventilation as applied elsewhere, for the cold air should enter at the bottom. While it is fairly practicable and pleasureable to have windows open during the warm months, they should remain closed during the cold season. Occasionally of course there are persons who desire to open them even in the winter, but their wishes should not be gratified on account of the inconvenience caused to other passengers. The interior of a car is narrow and symmetrical; people are placed close together and at regular intervals; therefore it is the feeling of the occupants as a whole that must be taken into consideration. We need pure air in our cars, and we need it at the proper temperature. Over-heated cars are more unhealthy than under-heated ones.

Two systems of ventilation are now being used; one dependent on the velocity of the train, the other a system of natural ventilation through the deck sash. One of the difficulties has been the comparatively short distance through

which the air travels in being raised to the required temperature.

The problem of properly heating the air, however, is one which will still require much experimentation. The growing use of the steel car has still further increased problems of this nature; being a good conductor of heat, it is more difficult to keep it at the required temperature.

Another problem is where to take the air into the car so that it will have a minimum amount of cinders and impurities. Certainly the air coming in at windows does not have this characteristic. As will be seen in an article on the subject published on another page, the contamination of air in passenger cars is relatively small, with the exception of still sleeping cars. The problem is then to introduce and maintain the air at a satisfactory temperature. The logical place for the intake seems to be on the roof, and the proper place to introduce the air into the car is at the floor. The Pennsylvania has been experimenting with a system along these lines, the air being lead in ducts underneath the car and passing through heating coils into the car at the floor level. This insures pure air at the breathing level, and with the use of good ventilators would seem to be the logical way to work out the problem. Taken separately, some good ventilating and heating devices have been brought out, but there is still much to be done in making them work together. Each is dependent upon the other.

ELECTRIC WELDING.

With respect to the use of electrical welding apparatus in the boiler shop, J. A. Shaw, electrical engineer of the Canadian Pacific Ry., is authority for the following comparison between between the oxy-acetylene and electric processes:

> "1st. The quality of the work performed by the electric system is of a higher grade because firebox or other boiler seams are not only securely welded together but the sheets are reenforced at the point welded by the addition of metal approximating ½ in. in thickness by 2 ins. to 3 ins. in width, thus greatly strengthening the sheets where they are united. 2nd. The absence of heat in the surrounding parts of sheets welded precludes th possibility of setting up strains of any kind in the metal and therefore the chance of cracks developing after the work has been completed. 3rd. There is entire absence of danger either from explosion, shocks to workmen or any other cause. 4th. One workman is required on each individual electric job while with the oxy-acetylene a helper is always necessary. 5th. For heavy work, such as welding mud rings, the cost is less with the electric welding than with the use of oxy-acetylene, while for building out sheets or welding up seams, there is but little difference in labor and material costs of operation.

Although the method is not new, some of the claims of superior results are new. As in the use of air and electric power for portable tools there are cases which are peculiarly adapted to either one or the other of the general welding processes. Mr. Shaw's results are, however, so strongly in favor of electricity for the great majority of boiler shop welding jobs, as to warrant considerable interest.

One of the most valuable of the possibilities of electric welding is the substitution of the process for that of riveting in joining seams on either new or old boiler work including the application of patches. Of course there is a prime drawback to the use of electricity for welding purposes, in that unless one particular class of work is to be turned out in large quantities, a heavy primary expenditure is required by the necessity for special electric welders and apparatus.

STEEL CARS.

The moment unfair tactics are introduced into a controversy either between individuals, classes or organizations, unprejudiced interest departs. It would not seem that the use of steel in the construction of railway equipment, limited as it has been, would be particularly objectionable to the far-seeing lumber interests. The howl (as a correspondent puts it) of the lumber interests can, however, hardly be ignored as it is heard from one end of the country to the other.

Not entirely without reason the use of steel in the construction of both passenger and freight cars has provoked protest from the displaced wood industry. When, however, the representatives of this industry stoop to malicious misrepresentation in their fight against the encroachments of the newer material, they lose not only the sympathy but the attention of the fair minded.

A lumber trade organ, the Hardwood Record, has made a blundering attempt to go into the subject technically and even goes so far as to reproduce photographs of steel cars which have failed supposedly from structural weakness. A pressed steel sill is shown distorted by an excessive buffing shock and attention called to the asserted fact that wooden sills would not have suffered. A steel gondola with a bulged side forms another illustration.

This line of argument resembles nothing so much as that of the man who wishes to equip locomotives with a fake smoke consumer. This man shows the motive power official two photographs, one representing a locomotive producing dense smoke while the other shows the same locomotive with a stack entirely clean. He then informs the official that the first picture was taken before and the other after the installation of his device. This man is surprised and hurt when told that his argument is not to be considered convincing to the technical man, and that further proof of efficacy must be made before further move is made.

Had the writer of the attack in question shown interest enough to inquire he would have learned that any kind of a car can be smashed into any kind of a wreck depending entirely on what happened to it. Weaknesses are, of course, found by examination of wrecked cars. These are sometimes avoidable and sometimes not, but they are found and remedied only by the technically qualified and not by the revengeful knocker at the progress of modern methods.

The excerpts below, clipped from the columns of the above-mentioned lumber trade periodical, show the bold and unsubstantiated position of those whose interests are affected by the advance of the steel car industry:

> "The promoters of steel car building and use are well aware of the frailties and the dangerous character of this type of equipment. They know that the danger to the traveling public is increased by the use of these cars; they know that these cars represent an extravagance in original cost, extraordinary expense in maintenance and haulage; that it

is with the utmost difficulty that they are kept on the track; that they have frequent derailments at switches and cross-overs; that they are uncomfortable vehicles in which to house passengers; that they are extravagant in the use of steam; that they are inimical to health; that they are deficient in resiliency; and that altogether they represent an unsafe, extravagant and fraudulent type of car.

"The public, and especially the lumber manufacturing and railroad public, should not fail to recall the fact that several very iniquitous bills are pending in Congress at the present time, making it obligatory on the part of railroads to employ full steel car equipment on their passenger trains within a very short time. An organized effort should be made to have the true facts of the character of steel cars thoroughly threshed out, and presented to Congress in such a forceful manner as to insure the defeat of these prospective pernicious enactments. Congress is again in session, and the steel trust will leave no stone unturned, and will not hesitate to spend every dollar necessary to secure, if possible, the enactment of these bills. It is time for a public awakening. It is time that a well-directed effort be made to defeat this pending legislation.

"The fight against the steel car is but one of the many necessary campaigns that should be undertaken by lumbermen."

TERMINAL BRAKE TESTING.

A paper on Terminal Brake Testing was read before the Western Railway Club, December 19, by F. B. Farmer. Considerable discussion was provoked by Mr. Farmer's statement that yards testing plants are not necessary for the efficient testing of freight car brake apparatus. Among those who discussed the subject was C. P. McGinnis, general air brake inspector, of the Minneapolis, St. Paul & Sault Ste. Marie, who was practically the only person heard to agree with Mr. Farmer. Mr. McGinnis explained the methods of his road in testing all incoming trains for defective brakes by means of a twenty pound brake pipe reduction from the engine before uncoupling it, and a close inspection of each car immediately following. By this means a check on the cars with defective brakes is obtained and in making up trains little or no switching is required to secure the minimum effective braking power per train. The opinions expressed by others, in discussing the subject, were, as stated above, not in agreement with Mr. Farmer and Mr. McGinnis. Some were frank to say that the plan described called for co-operation on the part of the transportation department, which could not be counted on.

To the unpredjudiced person it would seem that a refutation of the positive statements made by Mr. McGinnis would be well nigh impossible, the fact, however, that classification yards vary greatly in layout and that organizations of different stamps must be dealt with may be held partly accountable. The claim of lack of cooperation between the transportation and mechanical departments is, however, too severe an indictment to be seriously considered.

STEEL VS. WOODEN CONSTRUCTION FOR CARS.

Pittsburgh, Pa. Dec. 28, 1911.

Editor Railway Master Mechanic:

Some of the lumber interests have recently published articles, endeavoring to show that railway cars constructed of steel are unsafe on account of their rigidity and lack of *torsional resiliancy*. They seem to loose sight of the demand for cars of greater capacity and of the necessity for such cars having rigid construction in order that they will not shake to pieces in service.

The writer does not even agree with them that all steel cars lack torsional resiliancy. For instance, flat cars, low sided gondola cars and hopper cars having large bottom openings, lack in structure enough to permit the load to twist the car body in conformity with unevenness of the road bed. On the other hand, steel passenger cars, mail and baggage cars and all steel box cars are of such shape and rigidity that in running the car over a twisted track, the load is carried on two diagonally opposite side-bearings. The same is also true of new refrigerator cars and box cars when built of wood or combined wood and steel.

The comparatively soft and yielding nature of the wood, however, is such that these cars soon warp, and twist, and screech with all track irregularities. It results in box cars having leaky roofs, in refrigerator cars having their insulation torn and separated to such extent that *air* circulation *in* and *out* of the car lowers its efficiency as a refrigerator and adds very much to the *icing cost*. The operating departments of all railways which handle new refrigerator and other rigid cars know of the difficulties resulting from derailments until such cars have been distorted and twisted by rough usage.

This is all wrong, the cars should remain rigid, the roofs and sides should be maintained without distortion. Why shake a car to pieces and send it to the scrap pile years before it should be worn out? With the use of the new and better material (*steel*) in car construction it is only necessary to give greater flexibility between the truck and car body. In other words to permit of track irregularities without causing the car bodies to conform thereto. The Summers balanced side bearing truck carries a car over uneven track without distortion and without wheel flange wear. Any rigid car body can be carried more safely than a flimsy one; the reason being that the inclined truck hangers make vertical and horizontal adjustment, accommodating the rigid car or superstructure to any kind of twisted or distorted track.

The howls of the lumber interests are lost in the underbrush of the one-time forest. We are in the *age of steel* and are conforming to new conditions. The rigid steel car can now be and is being carried over rough tracks, the car body finding its own level as readily as a boat does floating in water.

E. W. Summers.

APPRECIATION AND SUGGESTION.

Editor Railway Master Mechanic:

During the course of our daily routine we have occasion to patronize a road which probably offers the best suburban service in Chicago. There is a certain train on which we always like to ride—it is a positive pleasure to have your fare collected. Why? Because the conductor of that train has a smile and a cheery word for everybody. It is "Fine morning," "Nice morning," and if he takes the last ride of your commutation ticket its "Guess you'll have to walk back." If you have your ticket punched for a friend also, he leans over in a confidential manner and says: "He's easy, isn't he?" That conductor enjoys his work, and is one of the best advertisements that road could have. Probably ninety-five per cent of the patrons of his train don't now his name, but they do now that he is the representative of the road, and to them he typefies the spirit of the railroad. The outsider who comes in contact with a railroad employee whether he be conductor, master mechanic or superintendent of motive power, considers that man the railroad. What do people think of your railroad? W. O. M.

Macon Shops, Central of Georgia Ry.*

The Central of Georgia Ry. operates three shops, one at Savannah, one at Columbus and one at Macon. The Macon shop has been completed and in operation a few months. The old shop at Macon occupied the same site as the new one and every effort was made to continue operations without delay while the new buildings were being erected and the machinery installed. The buildings are grouped to facilitate what inter-communication is necessary and to employ the ground space to the best advantage. In planning the lay-out of the buildings especial attention was given to ease and economical handling of material. The buildings are of steel and brick construction, with slow burning wooden roofs, the general design being clearly shown in the accompanying illustrations. The windows are large and numerous so that plenty of light is to be had at all times.

The power plant is located at about the center of the shops. The slope of the land is such that an exceptionally deep basement could be obtained without raising the engine room floor to an undesirable height above the general grade of the rest of the plant. Five 250-horsepower Stirling boilers are installed with an underground flue leading to the stack which is 9 feet in diameter and 175 feet high. Coal is delivered to the boiler room direct from cars on an elevated trestle and a narrow gauge railroad is provided for removing the ashes. Suitable provision is made for the installation of additional equipment in case it is needed.

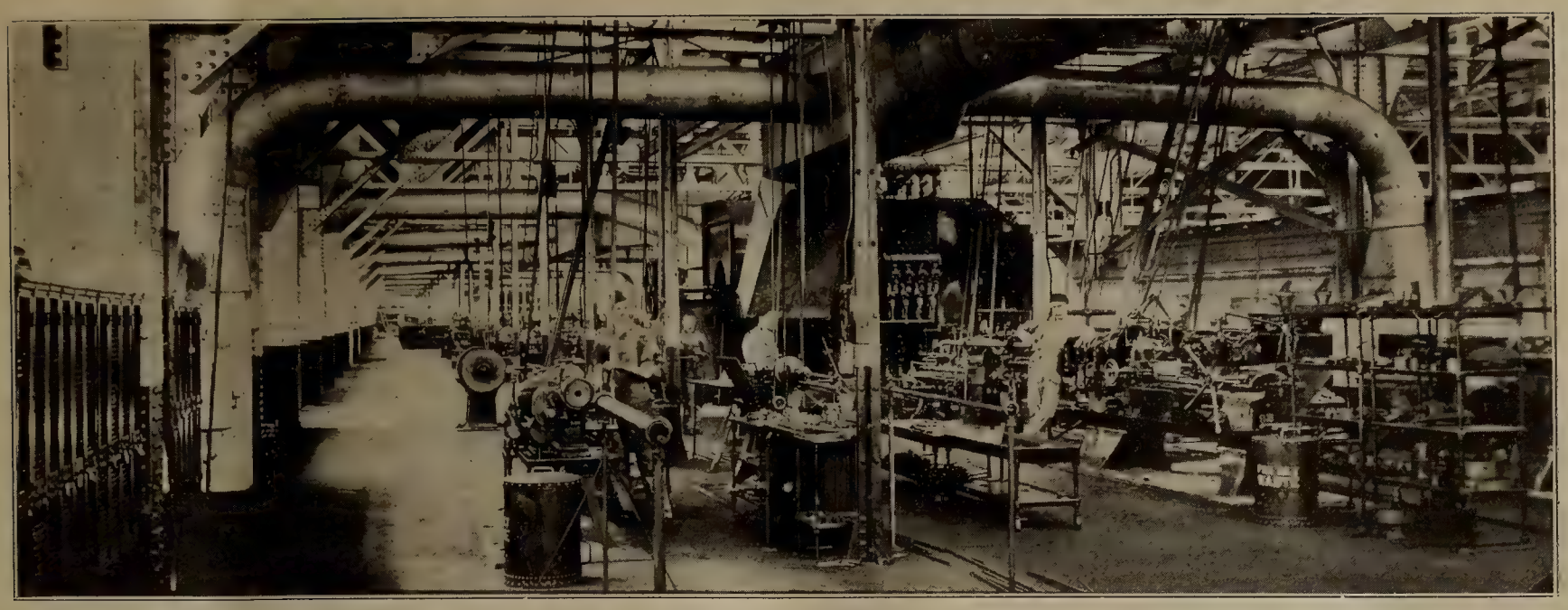
The engine room contains two 300 k. w. and one 500 k. w. Westinghouse turbines direct connected to alternating current generators, a Corliss cross compound Chicago Pneumatic Tool Company air compressor with a capacity of 2,000 feet of air a minute and the necessary auxiliary apparatus. The air compressor is direct connected to a fore-cooler from which piping conducts what air is needed to the various shops. The entire water supply is obtained from a private pumping station located on the Ocmulgee river about a mile from the plant. This plant was described on page 113 of the *Railway Master Mechanic* for April, 1910. An interesting feature is that the pumps, located at that river, are motor driven and directly controlled from the switch board in the power plant. The only attention given them is an occasional inspection and renewal of the oil for the bearings of pumps and motors. The buildings are equipped with an abundance of artificial illumination by means of Cooper-Hewitt mercury vapor lamps and portable incandescents.

The compressor and turbines may be run either condensing or non-condensing as desired. This enables the use of exhaust steam in the winter for heating purposes. The auxiliaries are steam driven and the exhaust used for heating the feed water. The auxiliaries, except the vacuum pumps, are located in the basement. The plant is provived with fire protection by means of a 1,000 gallon fire pump, located in the basement of the power house, and a 50,000 gallon high pressure elevated tank erected near the power house. In case of emergency the service pumps at the river can be used for fire fighting.

The master mechanic's office is a substantial red brick

General View of Macon Machine Shop, Cent. of Ga. Ry.

* The illustrations published with this article were obtained by courtesy of the editor of Southern Machinery, Atlanta, Ga., which journal printed a similar article in its November issue.



Balcony of Macon Machine Shop, Cent. of Ga. Ry.

structure arranged for the offices of the shop executives and general clerical force of the works. The blacksmith shop is 100 feet wide and 260 feet long with a two-story annex. The first floor of the annex is used for lavatories and the second floor for housing the volume and pressure blowers supplying air to the forges. A general view of the interior of the blacksmith shop is shown herewith. There are no traveling cranes installed, but the different forges and hammers required for heavy work are served by revolving jib cranes which also reach the narrow gage industrial railway shown in the illustration. The forges for light hand work are set at an angle in two rows down the center of the shop. Each forge is double with the fires facing in opposite directions.

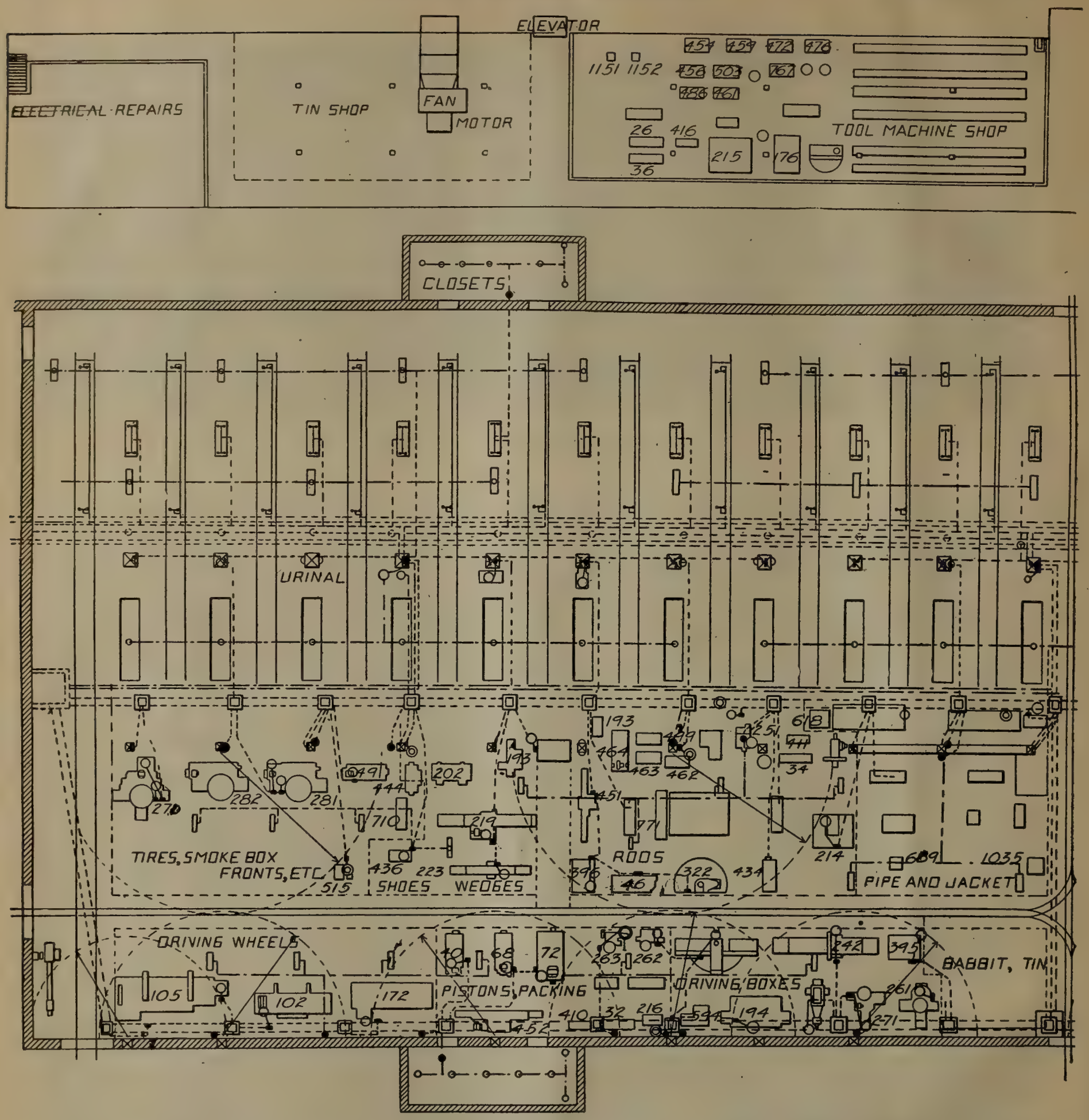
The blast is furnished by a blower located in the annex. The machines such as rod heating furnaces, bulldozers, bolt machines and hammers are located around the building wall near the windows and the furnaces for this work are all oil burners obtaining the air pressure from the blowers in the annex. In this illustration is shown a 3,000 pound double frame steam hammer and a 400-ton steam hydraulic forging press. This shop is connected with the storage yard and the machine shop by the industrial railway. A monitor roof is provided for the blacksmith shop to provide suitable lighting and ventilation.

Blacksmith Shop Tools.

Description.	Maker.	Drive.
Steam Hammer, 3,000 Pounds	Bement	Steam.
Steam Hammer, 1,000 Pounds	Bement	Steam.
Steam Hammer, 800 Pounds	Bement	Steam.
Steam Hammer, S. F., 800 Pounds	Ryerson	Steam.
Steam Hammer, S. F., 600 Pounds	Ryerson	Steam.
Steam Hammer, S. F., 400 Pounds	Minningham	Steam.
Steam Hammer, S. F., 2,000 Lbs.	Ryerson	Steam.
Steam Hammer, S. F., 400 Pounds	Minningham	Steam.
Steam Hammer, S. F., 2000 Lbs. Treadle.	Ryerson	Steam.
Steam Hammer, S. F., 200 Pounds Treadle.	Ryerson	Steam.
Steam Hammer, 1,000 Pounds	Chambersburg	Steam.
Steam Hammer, 1,600 Pounds	Chambersburg	Steam.
Gorging Press, 400 Ton	Chambersburg	Steam Hyd.
Scrap Rolls	Ajax	Motor.
Guillotine Shear, outside stock	Hilles & Jones	Motor.
Guillotine Shear (Gantry)	Hilles & Jones	Motor.
Trimming Press, No. 7	White	Motor.
Forging Machine, 4"	Ajax	Belt.
Forging Machine, 2½"	National	Belt.
Forging Machine, 1"	National	Belt.
Bolt Cutter, 2" Triple Head	Acme	Belt.
Pressure Blower (Furnaces), 45 H. P.	A. B. Co	Motor.
Volume Blower, (Forges), 25 H. P.	A. B. Co	Motor.
Eye Bender, No. 2	Obeymayer	Hand.
Eye Bender, No. 3	Obeymayer	Hand.
Bolt Header, 2½"	Ajax	Motor.
Oil Furnace, No. 1	Ferguson	Oil.
Oil Furnace, No. 1	Ferguson	Oil.
Oil Furnace, No. 184. (for 400 ton presses).	Ferguson	Oil.
Oil Furnace, No. 143, (for 3,000 Lb. Hammer).	Ferguson	Oil.
Oil Furnace, No. 136, (for 1,000 Lb. Hammer).	Ferguson	Oil.
Oil Furnace, No. 3, (for Bolts)	Ferguson	Oil.
Oil Furnace, No. 2, (for Bolts)	Ferguson	Oil.
Oil Furnace, No. 2, (for Bolts)	Ferguson	Oil.
Oil Furnace, Sheet, Ill., (Spring Banding).	Ferguson	Oil.
Oil Furnace, Bulldozer (Scrap Rolls).	Ferguson	Oil.
Oil Furnace, Combined Case, Hardening and Spring.	Ferguson	Oil.
Oil Furnace, Special for Spring Pointing Rolls.	Ferguson	Oil.
Punch & Shear (Spring Work)	Evans	Motor.
Point Rolls (Spring Work)	Evans	Motor.
Gas Furnace, No. 60, Chloro	Stewart	Gas.
Gas Furnace, No. 1, Preheater (Tool Dresser).	Stewart	Gas.
Gas Furnaces (High Speed Steel Tool Dresser).	Chicago	Gas.
Pyrometer, (Tool Dresser)	Hoskins	
Punch and Shear	Hilles & Jones	Motor.
Air Bender		
Spring Bending Machine		
Bolt Cutter, Triple Head	Acme	Belt.
Bolt Cutter, Single Head	National	Belt.
Oil Furnace, No. 135	Ferguson	Oil.
Bolt Cutter, Double Head	Steele-Harvey	Belt.

The machine shop is 510 feet long, and is divided longitudinally into three sections; one for the machine shop, 70 feet wide; one for cleaning and storage small parts, 45 feet wide; and one 60 feet wide for an erecting shop. The machine tool arrangement is shown in drawing. The erecting shop contains two crane runways, one above the other. The upper one carries a 120-ton crane, used for lifting the locomotives and other heavy work, while the lower crane has a capacity of 10 tons and may be considered as a general utility crane. The lower runway extends uninterrupted into the boiler shop at one end of the machine shop building. Thus the lower crane is able to transfer boilers, tubes, cabs, etc., from one shop to the other without rehandling.

The locomotive stalls are on 13 foot centers, thus leaving sufficient room between locomotives being repaired, for the workmen. Just back of the erecting floor a number of tanks are embedded in the floor, containing lye water for removing the grease and dirt from the parts stripped from the locomotives. These tanks are equipped with drainage and steam pipes for heating the lye water. After cleaning, the parts are washed and stored in the storage space until they are again wanted. Heavy wooden covers are provided for the lye tanks so that the whole floor is available and there is no danger of workmen falling into the lye water while passing to and fro. The floor is cement and the distance to the roof girders is 50 feet. The windows extend to the roof and the roof contains large skylights, affording excellent light during the day and seldom if ever are the electric lights required.

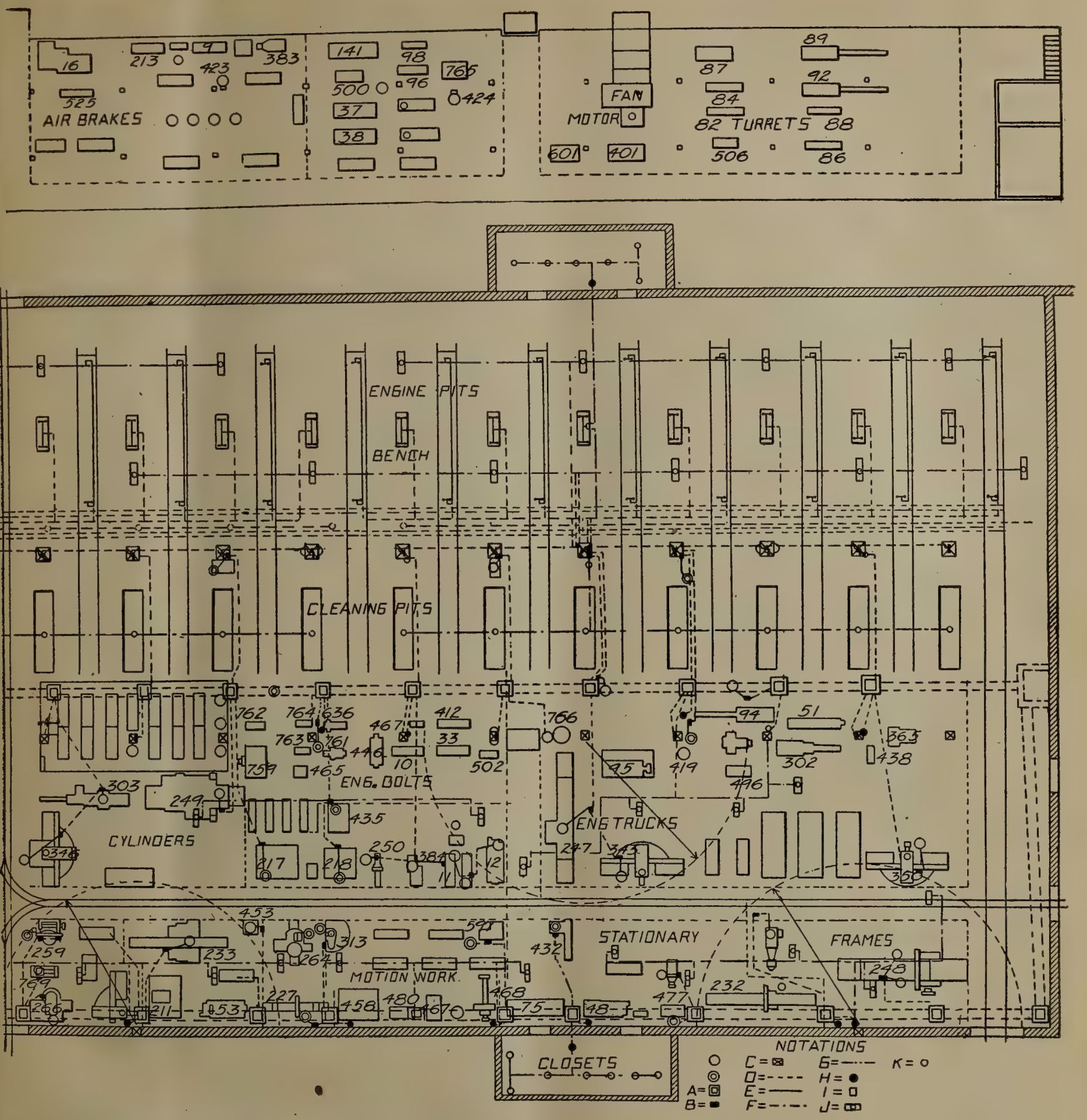


Plan of Macon Machine and Erecting Shop

Power such as electric, air, and steam for use in operating portable tools is obtained from a tunnel extending the full length of the shop in front of the engine stalls. Wiring for portable electric lights such as are required in the pits and boilers is also laid in this tunnel, as well as the piping for oil. Provision is made by means of service boxes at each stall for cutting out any one or all circuits as desired. This arrangement has been found very convenient as each engine can be repaired independently of those in the immediate neighborhood and no time is lost in waiting for another repair crew to finish an operation.

The lower floor of the storage space is used for fitting engine driving boxes before wheeling engines, and other medium heavy hand work. The upper floor is given over to light machinery operations, such as tool manufacture, and is in direct communication with the distributing tool room on the main floor by means of an electric elevator. The repair departments for electrical apparatus, air brake equipment, injectors, lubricators and gages, and the tin shop are also located in this balcony. Two small electric elevators are provided for lifting material from the main floor to the balcony. The balcony is very completely equipped for the work to be done there and would excite the envy of many owners of shops doing small and medium sized work.

The main machine shop is well arranged with tools ranged along the sides of a main passage way down which is laid the tracks of the industrial railway. The power required in this shop is generated in the central power plant and all tools are either direct connected to electric motors or operated from short line shafts in groups. The larger tools are



with Balcony, Central of Ga. Ry.

all direct connected to electric motors equipped with suitable starters and speed controllers. This shop is well provided with cranes for handling work on the floor and at the machines. An interesting feature in connection with the engine wheel lathes is that the speed of cutting is automatically regulated according to the hardness of the tire being turned. This is regulated by a series of switches, shunts and resistances governing the current supplied to the motors.

Throughout the shop the convenience and comfort of the employes have received careful attention. Numerous drinking fountains and urinals are conveniently installed, while clean light lavatories and wash rooms are situated at suitable points. Janitors are constantly in attendance and every effort made to maintain the best possible sanitary conditions. Ventilated lockers for employes' clothing are suitably placed within easy reach of the machines and are sufficiently plentiful so that each man has his individual compartment. The floor is made of creosoted blocks which has proved very satisfactory. The general tool arrangement has been selected with a view to eliminating handling of the work as much as possible. This result has been obtained by grouping machines according to the classes of work rather than according to the kinds of machines. Thus each group of machines forms a complete unit and is constantly employed upon one kind of work.

Machine Shop Tools.

Cylinder Heads and Castings.

Description.	Maker.	Drive.
Planer, 26"x26"x8'0"	Niles	Motor.
Boring Mill, 36" Vertical Turret	Bullard	Belt.

Steam Chests and Valves.

Lathe, 26"	Lodge & Davis	Belt.
Planer, 36"x36"x10'0"	Pond	Motor.
Miller, No. 4	Brown & Sharpe	Belt.
Grinder, Magnetic Chuck	P. & W.	Motor.

Tires, Wheel Centers, Axles, Smoke Box Fronts.

Wheel Lathe, 80," Quartering and Journals	Niles	Motor.
Boring Mill, 84"	Niles	Motor.
Boring Mill, 84"	Niles	Motor.
Tire Lathe, 90"	Putnam	Motor.
Axle Lathe, Driving, 24"	Schumaker & Boye	Motor.
Boring Mill, 72"	Niles	Motor.
Wheel Press, 600 Ton	R. D. Wood	Motor.
Surface Plate		
Lathe, 42" Steel Tired Car Wheel	Putnam	Motor.
Oil Furnace, Heating Tires	Ferguson	
Keyseater, Driving Axle	Ryerson	Motor.

Rod Work.

Shaper, 26", Keys and Liners	Norton	Belt.
Lathe, 24", Rod Brasses	Reed	Motor.
Lathe, 18"x8'0", Crosshead Pins	LeBlond	Belt.
Sensitive Drill, 12"	Knecht	Belt.
Guide Grinder, 30"	Bridgeport	Motor.
Shaper, 32", Single Head	Cincinnati	Belt.
Boring Bill, 36" Rod Bushings	Bullard	Motor.
Grinder, No. 12, Spiral Groove, Shear Cut	Gardner	Belt.
Grinder, No. 6, Spiral Groove Shear Cut	Gardner	Belt.
Hydraulic Bushing Press, 100 ton.	Watson-Stillman	Belt.
Radial Drill, 4'0" Back Geared	Bement	Motor.
Vertical Miller, 66" small table and crane	Bement	Motor.
Swing Frame Grinder, No. 2	Springfield	Belt.
Floor Grinder, No.-d	Bement	Belt.
Cold Saw, No. 16 Higley	Bement	Motor.
Vertical Drill, 44" heavy	Foote-Burte	Motor.
Center Drill, 5" Stock	Packard	Belt.
Laying Off Surface Plate		
Two Work-benches, Standard with Merritt 6" Vises.		

Link Work.

Link Grinder	Hammett	Belt.
Universal Grinder (Bushings)	B. & S.	Belt.
Radius Planer Attachment	Underwood	
Crank Planer, 16"x24"x40"	Bement	Motor.
Lathe, 24"x10'0"	Reed	Motor.
Lathe, 14"x5'0"	Reed	Motor.
Lathe, 14"x5'0"	Reed	Motor.
Sensitive Drill, 12"	Knecht	Belt.
Vertical Drill, 36"	Foote-Burte	Motor.
Miller, 5-B, Heavy Plain	LeBlond	Motor.
Link Grinder, Heavy	Hammett	Belt.
Grinder, Double Spindle, Horizontal Attachments	Springfield	Belt.
Miller, No. 5 Vertical	Ingersoll	Motor.
Bushing Press, 25 ton Hydraulic	Wood	Motor.
Cut-off Saw, No. 16 Q and C	Higley	Motor.
Three Work-benches, Standard Merritt 6" vises.		
Three Shelves, 36"x20", New Britian	N. B. M. Co.	
Radial Drill, 3 ft	Bement	Motor.
Arbor Press, No. 3½	Bartlett	
Arbor Press, No. 3½	Bartlett	
Arbor Press, No. 3½	Bartlett	
Arbor Press, No. 3½	Bartlett	

Brass Foundry.

Melting Furnace, No. 360	Steele-Harvey	
Ladle Heater	Steele-Harvey	
Pressure Blower	Steele-Harvey	Motor.
Tumbling Barrel and Sieve Cap.	Globe M. & S.	Belt.

Driving Boxes.

Shaper, 32" Special Draw-stroke	Morton	Motor.
Bushing Press, 100 ton	Watson-Stillman	Belt.
Vertical Drill, 44" Compound Table.	Foote-Burte	Motor.
Boring Mill, 56"	Bullard	Motor.
Slotter, 15" High Speed Movement.	Drill	Motor.
Planer, 48"x12'0," 4 head	Woodw'rd & Powell	Motor.
Boring Mill, 44" old car wheel with double chuck	Rogers	Belt.
Radial Drill, Double Base, 6' Semi-radial	Bickford	Motor.

Pipe Group.

Pipe Threader, 6"	Wieland	
Pipe Bender, Pneumatic	Underwood	Air.
Pipe Threader, 3"	Coxe	Motor.
Oil Furnace, Small Brazing and Bending	Ferguson	Oil.

Babbitt and Tin Work.

Furnace, Heating Metal	Tate-Jones	Oil.
Furnace, Melting Off and Heating.	Tate-Jones	Oil.

Pistons, Piston Packing and Piston Rods.

Grinder, Piston Rod	Landis	Motor.
Vertical Turret 36"	Bullard	Motor.
Lathe, 18"x5'0"	Schumaker & Boye	Belt.
Vertical Turret, 36"	Bullard	Motor.
Lathe, 36" to swing 23" Over Carriage	Pond	Motor.
Lathe, 20" High Speed Reducing	LeBlonde	Motor.
Center Drill, 5" Stock	O. L. Packard	Belt.
Keyway Mortiser	Bement	Belt.
Lathe, 30"	LeBlonde	Motor.

Staybolt Group.

Bolt Threader, 4 Spindle	Lassiter	Belt.
Tell-tale Drill, 4 Spindle	Lassiter	Belt.

Engine Bolts-Down Stairs.

Lathe, 18"	Lodge & Shipley	Belt.
Lathe, 14"	(do)	Belt.
Center Drill, small	P. & W.	Belt.
Bolt Pointer, 2"	National	Belt.
Bolt Cutter, ½x3" Triple Head	National	Belt.
Grinder, No. 12 Spiral Groove	Gardner	Belt.
Nut Facer, 3-8 to 1½"	Victor	Belt.
Nut Facer, 1½ to 3"	Victor	Belt.
Bolt Alterer	W. H. Foster	Belt.
Center Drill, 2 Spindle, 4"	Whiton	Belt.
Bolt Machine, 4 Spindle	Lassiter	Belt.
Grindstone	C. of Ga	Belt.
Shelves, 36"x20" New Britian	N. B. M. Co	
Grinder, Double Spindle, Horizontal Attachment	Springfield	Belt.

Turret Lathe Group.

Flat Turret, 2"	Jones & Lamson	Belt.
Flat Turret, 3"	Jones & Lamson	Belt.
Flat Turret, 3"	P. & W.	Belt.
Heavy Turret, 6"	Pond	Belt.
Turret, Chucking Outfit, 6"	Steinlee	Motor.
Turret, Set Screws, 1"	P. & W.	Belt.
Turret, 1" Set Screws	P. & W.	Belt.
Turret, 1½" Patch Bolts	P. & W.	Belt.
Turret, 3"	W. & S.	Belt.
"D" Grinder	Springfield	Belt.
Shelves, 36x20" New Britian	N. B. M. Co	

Air Brakes—Lubricators.

Steam Gauge Tester	Crosby	
Auto. Cock Grinder, 8 Spindle (For Car Shop)	Crosby	Belt.
Two Triple Rollers	Westinghouse	Hand.
Two Triple Racks (1 for car shop)	Westinghouse	Hand.
Vertical Cylinder Grinder	Saxon Mach. Co	Belt.
Sensitive Drill, 12"	Knecht	Belt.
Lathe, 14" Taper Attachment	LeBlond	Motor.
Lathe, 14" Taper Attachment	Lodge & Shipley	Belt.
Vertical Drill, Back Geared	Foote-Burte	Belt.
Center Drill, 2", Spindle, 4" Stock	Whiton	Belt.
Cut-off Saw No. 16	Q. & C	Motor.
Test Rack, air pumps	Westinghouse	
Test Rack, injectors	Westinghouse	
Test Rack, lubricators	Westinghouse	
Test Rack, Engineers' Valves	Westinghouse	
Six Work Benches, Standard	C. of Ga	
Four Revolving Racks, No. 172	New Britian	
Cleaning Vat	C. of Ga	

Driving Brakes.

Vertical Drill, 36"	Foote-Burte	Belt.
Lathe, 26"	C. of Ga	Belt.
Sensitive Drill, 12"	Knecht	Belt.
Floor Grinder, D	Springfield	Belt.
Work Bench, Standard	C. of Ga	

Cylinders.

Planer, Special Draw-stroke Cylinder	Morton	Motor.
Drill, 6 ft. Semi-radial	Bickford	Motor.
Cyl. Boring Machines, Plain	Newton	Motor.

Shoes and Wedges.

Cold Saw, No. 20, 36"	Higley	Motor.
Shaper, 24" D Head	Cincinnati	Belt.
Miller, 36"x36"x12'0" (Locate near Rods)	Ingersoll	Motor.
Planer, High Speed 24"x24"x12'0"	Pond	Motor.
Grindstone	C. of Ga	Belt.

Engine Trucks.

Drill, 6 ft. Semi-radial	Bickford	Motor.
Planer, 48"x48"x12'0" Open Side	Cleveland	Motor.

Brass Work.

Turret Lathe, 18" Brass	Fox	Belt.
Turret Lathe, 18" Fox, Brass	Fox	Belt.
"D" Grinder	Blount	Belt.
Lathe, 18" Quick Change Gear	LeBlond	Motor.
Lathe, 18" Quick Change Gear	LeBlond	Motor.
Brass Separator, Electro-magnetic.	Gen'l Electric	Motor.
Lathe, 14" Taper Attachment	Niles	Motor.
Lathe, 14" Taper Attachment	Niles	Motor.
Sensitive Drill, 12"	Knecht	Belt.
Turret, 18" Fox	W. & S.	Belt.
Six Shelves, 36x20" New Britian	N. B. M. Co	

Frames.

Slotter, 18" (2 Independent Tool)	Drill	Motor.
Planer, Low Rail, 60"x60"x18', 4 Heads.	Pond	Motor.
Radial Drill, 7 ft. Heavy Double Base.	Dresses	Motor.

Tool Room.

Tool Room Grinder, Universal	Walker	Belt.
Cutter Grinder, No. 2	Cincinnati	Motor.
Grinder, Twist Drill	Sellers	Belt.
Grinder, Tool, Universal	Sellers	Motor.
Tool Room Grinder, 12" Universal.	Walker	Motor.
Miller, Universal, Rack Cutting	Hendy	Belt.
Sensitive Drill, 12"	Knecht	Belt.
Radial Drill, 3 ft	Bement	Motor.
Shaper, 15" Universal	Potter & Johnson	Motor.
Grinder, Double Spindle, Horizontal Att.	Springfield	Belt.
Lathe, 16"	Hendey-Norton	Motor.
Lathe, 18"	Hendey-Norton	Motor.
Center Drill, 3" Single Spindle	Whiton	Belt.
Filing Machine, No. 2	Cochrane-Bly	Belt.
Grinder, Staybolt Dies	Modern Tool Co	Belt.
Grinder, Auto Saw	Higley	Belt.
Eight Racks, No. 172, Revolving	New Britian	
Four Shelves, 36x20"	New Britian	

Eccentric Straps and Blocks.

Eccentric Mandrel	Underwood	
Boring Mill, 51"	Niles	Motor.
Boring Mill, 42" Rapid Reduction	Bullard	Motor.
Keyway Morticer	Norton	Motor.
One Laying-off Table	C. of Ga	
One Work Bench Standard	C. of Ga	
Radial Frill, 6 ft	Niles	Belt.

Miscellaneous—Stationary.

Lathe, 37"	C. of Ga.	Belt.
Palmer, 36"x36"x14"	Bement	Belt.
Boring Mill, Horizontal	Niles	Belt.
Lathe, 24"	Le Blond	Belt.
Drill, 36" Vertical	Foote-Burte	Motor.
Power Hack Saw, Small	Q. & C.	Belt.
Belt Lacer	Jackson	Hand.
Cold Saw, 14" Combination	Newton	Motor.
Slotter, 14"	Sellers	Belt.
Oil Separator	American Cent.	Belt.
Scale, 5 ton, Compound Suspension	Fairbanks	
Center Drill, 4" Stock	Whiton	Belt.
Three Time Recorders	International	

Erecting.

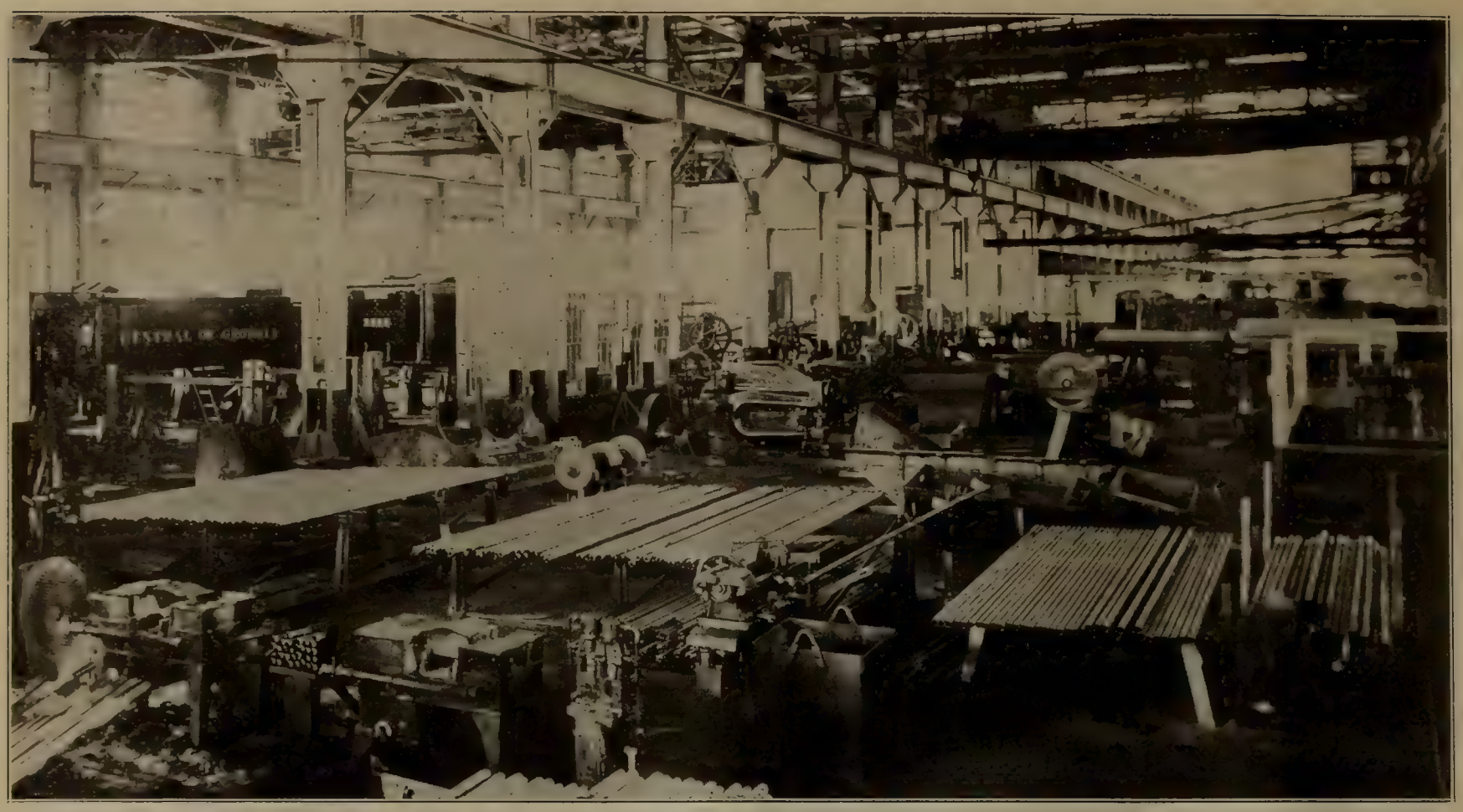
Vertical Drill, 36"	Foote-Burte	Motor.
Vertical Drill, 36"	Foote-Burte	Motor.
Portable Furnace, Braces, etc.	Furguson	Oil.
Portable Furnace, Braces, etc.	Furguson	Oil.
Floor Grinder, "D"	Springfield	Motor.
Floor Grinder, "D"	Springfield	Motor.
Valve Setter	Farrington-Mills	Air.
Crank Pin Press, 100 ton, Hydraulic.	Dudgeon	
Dome Facer	Underwood	
Crank Pin Turner	Underwood	
Valve Seat Facer	Underwood	
Cylinder Boring Bar, 4"	Ryerson	Motor.
Four Air Drills, Close Corner, No. 8.	"Thor"	
One Air Drill, No. 6 Non-Reversible.	"Thor"	
Two Air Drills, No. 1 Piston	"Thor"	
One Air Drill, No. 2 Piston	"Thor"	
One Breast Drill, No. 10	"Thor"	
Three Chipping Hammers, No. 5	"Thor"	
Twenty-one Work Benches, Special with 2 each Merritt 6" Vises.		
Six Vise Stands, 5" Portable	New Britain	
One Burner for Testing Locomotives.	Tate-Jones	Oil.

The boiler and tank shop is 260 feet long and 130 feet wide, and is divided into two bays, one 60 feet wide used for erecting and the other 70 feet wide used for flanging, punching, shearing and other work of a similar nature. The boiler and tank shop is divided from the locomotive and machine shop by a fire wall with two main entrances, and through which the industrial railway enters, and the other through which the lower crane from the locomotive erecting floor enters. As previously stated this runway extends uninterrupted through both shops. Every facility has been provided for the rapid handling of work. In the end of the 60-foot bay nearest the erecting shop is located the equipment for making boiler repairs. The other end is used for flue work. In the end of the 70-foot bay nearest the machine shop, flanging, etc., is done, while at the other end tender and tank repairs are made. This shop is provided with riveters, hammers, shears, flanging and flue machines. The roof is saw-tooth construction, permitting excellent natural illumination at all times. This shop is amply provided with cranes, to facilitate handling of work.

.General Vlew of Macon Blacksmith Shop, Cent. of Ga. Ry.

Boiler Shop Equipment.

Description.	Maker.	Drive.
Vertical Drill, 44"	Foote-Burte	Motor.
Horizontal Flange Drill	Beaman Smith	Motor.
Radial Drill, 6 ft.	Bickford	Motor.
12 ft. Plate Planer	Cleveland	Motor.
Large Annealing Furnace	Ferguson	Oil.
Hydraulic Pump, Triplex	R. D. Wood	Motor.
Hydraulic Pump, Triplex	R. D. Wood	Motor.
Hydraulic Accumulator	R. D. Wood	Hydulic.
Hydraulic Flanging Press, 200 tons.	R. D. Wood	Hydraul.
Hand Clamps	C. of Ga.	Hand.
Bending Rolls, 12 ft.	Cleveland	Motor.
Horizontal Punch	Cleveland	Motor.
Punch, 60" Gap	Cleveland	Motor.
Shear, 60" Gap	Cleveland	Motor.
Angle Shear	Long & Allstatter	Motor.
Rotary Bevel Shear	Lennox	Motor.
Punch ½" Plate	Lennox	Motor.
Friction Saw	Ryerson	Motor.
Rotary Shear	Kling	Motor.
Rollers, 8 ft.		Belt.
Drill Grinder, No. 1½	Champion	Belt.



Boiler and Tank Department.

Sensitive Drill, 12"	Knecht	Belt.
Vertical Drill, 36"	Foote-Burte	Motor.
Hand Rolls	C. of Ga	
Grinder	Springfield	Motor.
Flue Cutter	Fox	Motor.
Welding Machine, Flues	McGrath	Air.
Welding Machine, Flues	Ferguson	Oil.
Safe End Furnace, Flues	Ferguson	Oil.
Rivet Furnace	Calorex	Belt.
Rivet Furnace	Calorex	Belt.
Rivet Furnace (Tanks)	Ferguson	Oil.
Flue Rattler	C. of Ga	Motor.
Port Rivet Furnace	Ferguson	
Port Rivet Furnace	Ferguson	
Mud Ring Riveter	Ryerson	Hyd. Air.
Staybolt Nipper	W. H. Foster	
Double Punch and Shear, Tanks	Hilles & Jones	Belt.
Drill Grinder, No. 1, 2	Champion	Belt.

Extending along the side of the blacksmith shop, the machine shop and the boiler and tank shop is a material platform served by a 15-ton gantry crane. Suitable magnets for handling scrap, plates and other material are provided. All heavy material used in the department mentioned is removed directly from cars onto this platform from which it is taken into the shops as needed. This platform is also used for sorting and storing scrap. The tire furnace is located on this platform opposite the large wheel lathes in the machine shop. At the end of this platform nearest to the flue department is located a flue rattler of the old cylindrical style, but arranged to be automatically filled after the flues are lifted into a cradle above the machine by the gantry crane. After being cleaned the flues are delivered to a somewhat similar cradle lower than the one mentioned from which they can be collected and removed by the crane.

The roundhouse is located some distance from the erecting and machine shop. This was partly necessary owing to the property lines. The outside walls are carried out to form a building of rectangular shape, the corners of which are utilized for the roundhouse machine shop. All the tools necessary for the work to be done are installed and no necessity has been found for carrying work to and from the main shop unless of extremely unusual character. The roundhouse is connected to the rest of the works by switch and industrial tracks and standard parts are carried in stock in the roundhouse store room.

An interesting feature of the roundhouse is an electrically operated drop table by means of which all the drivers or any of them may be dropped at one time. An electric mono-rail hoist is provided for carrying the wheels to the lathe in the machine shop for truing the journals. Two other tracks are provided for with wheel pits for handling single wheels and outside is located a pit for tender wheels.

Roundhouse Equipment.

Description.	Maker.	Drive.
Lathe, 24"	Le Blonde	Motor.
Volume Blower, Heating System	A. B. C	Motor.
Lathe, 14"	Reed	Motor.
Vertical Drill, 36"	Foote-Burte	Motor.
Hydraulic Press, 100 Ton	Watson-Stillman	Motor.
Shaper, 30" Draw Cut	Morton	Motor.
Cylinder and Valve Seat Facer	Underwood	
Air Valve Setter	Farrington Mills	
Hydraulic Crank Pin Press	Watson-Stillman	
Sensitive Drill, 12"	Knecht	Belt.
Turret Head, Bolt Cutter, No. 4	P. & W	Belt.
Pipe Machine, 3"	B. & K	Belt.
Drop Apron Grinder, No. 5	Bridgeport	Motor.
Punch and Shear, No. 17	White	Motor.
Double Head Grinder	Bridgeport	Belt.
Center Drill, 2" 2 Spindle	P. & W	Belt.
Saw, No. 16	Higley	Motor.
Crank Pin Turner	Underwood	
Dome Facer	Underwood	
Boring Mill, 72"	Niles	Motor.
Wheel Lathe, 80"	Niles	Motor.
Rolls, No. 1	Hilles & Jones	Motor.
Vertical Turret, 36"	Bullard	Motor.
Pipe Bender	Underwood	Air.
Bolt Alterer	Potter & Johnson	Belt.
Motor (New Shop), 15 H. P.	Westinghouse	
Motor (Tool Room), 15 H. P.	Westinghouse	
Motor, Portable, 3 H. P.	Westinghouse	
Crane, 5 Ton Trolley	Niles	Motor.
Vacuum Pump, Heating System	Ill. Engr. Co	Steam.
Turbine Pump, Boiler Washing	Alberger	Motor.
Turbine Pump, Boiler Washing	Alberger	Motor.
Grease Forming Machine	Underwood	Air.
Hose Mounting Outfit, 20th Century	Buker & Carr	Air.
Turn Table Travtor	Nichols	Motor.
Sand Dryer	Robertson	
Time Recorder	International	
Time Recorder	International	
Boiler Tester	Bellfield	
4½" Boring Bar	Underwood	Belt.

In the drawing of the machine shop floor plan the electrical wiring is designated as follows: O is a motor; A is a distributing hand-hole; B is a motor controller; C is distributing board; D is circuit under floor; E is circuit above floor on benches or machines; F circuit on ceiling; G is circuit under balcony floor; H is a switch, I is receptacle, 100 volts D. C.; J is a type F Cooper-Hewitt lamp; K is an incandescent lamp.

PASSENGER CAR VENTILATION.

Up to the past few years practically no advance has been made in the ventilation of passenger cars, the ventilation being little better than it was in the old fashioned stage coach. Not but that study and attention have been given to the subject. About 1868 Prof. Nichols, of the Massachusetts Institute of Technology, made some investigations of a system whereby air entered the car at the front end under the hood and again passed out under the rear hood. This system, however, never proved a success. In 1875 two Germans, Wolfhugel and Lang, made a study of the subject and further investigations were carried on in 1887. About 1890 the Pennsylvania R. R. took up the subject and a brief investigation was made; a more extended one being made in 1894. The Master Car Builders' Association has had a number of committees on the subject, the first in 1874, another in 1894 and still a third in 1908. It will be remembered that in the Reminiscences of a Master Car Builder published in the November issue of the *Railway Master Mechanic*, it was stated that a member replied to a circular letter on the subject at the 1874 convention saying that "the amount of air required to keep the car pure depends on the class of stock carried. In some of our trains if you were to take out both ends of the car I doubt if the air of the rear end would be fit to breathe." The report of 1908 was very complete and handled the subject clearly; nevertheless the information on the subject is not very extensive.

At the present time considerable interest is being shown in heating, ventilating and pure air problems in general and especially as applied to the passenger car. The traveling public expects cars which are well ventilated and in which the heat is well regulated. The road which caters to these desires and lets the people know that it does, is going to get the business. Those who have much occasion to use the sleeping cars of today know only too well that their present condition is far from ideal. But when you lay a carefully assorted lot of people along next to each other in regular rows, it is hard to satisfy everybody. In the dressing room one morning a few weeks ago, a fellow passenger said: "Suffering Moses, I nearly baked in my berth last night." "Dat so, bos," said the porter, "dat's funny; you know I had to get two extra blankets for dat fellow in upper ten; yes sah." Something certainly should be done to improve the ventilation and heating so as to obviate such extreme opinions.

During the past year a number of interesting and valuable papers on this subject have appeared. Among these are "Recent Developments in Car Heating and Ventilation," a paper by L. C. Ord, general car inspector of the Canadian Pacific, read before the Canadian Railway Club; a committee report on the Ventilation of Cars read before the American Medical Association and a paper entitled, "A Study of the Ventilation of Sleeping Cars," by Thomas R. Crowder, of Chicago. We are indebted to the later for the illustrations and much of the test data given below. It is worthy of note that in these papers, heating and ventilation are closely interwoven and each is treated with respect to the other.

The amount of carbon dioxide in pure air is about 4 parts in 10,000, but this runs a trifle higher in cities. The amount in air exhaled from our lungs runs very high, being about 400 parts in 10,000. An ordinary railway coach with no ventilation and containing twenty people would have about 34 parts per 10,000 of carbon dioxide at the end of an hour and this of course could continue to increase with the time. The M. C. B. report of 1894 in the results of tests, found an average of 18 parts of carbon dioxide in 10,000, in sleeping cars containing an average of 12.5 passengers and 10.7 parts in chair cars containing an average of 17.4 passengers. It is presumed that these observations were made while the cars were in motion. Dr. Dudley's report on Pennsylvania cars in 1894 stated that he found from 10 to 18 parts in running cars and about 20 parts in cars that had been standing for 20 minutes.

Knowing the amount of carbon dioxide in pure air, the amount in the air of the car and the number of cubic feet of carbon dioxide exhaled per hour by each person, the number of cubic feet of air required per person to keep the contamination of the car air constant may be readily figured out. Figure 1 is a curve showing this relation as computed by Dr. Crowder.

There are two general classes of ventilation, the natural or deck sash method and the exhaust method.

Deck Sash Ventilation.

The natural method is the one used on the majority of cars and really is not a system of ventilation at all as the deck sash windows are simply opened to let out as much of

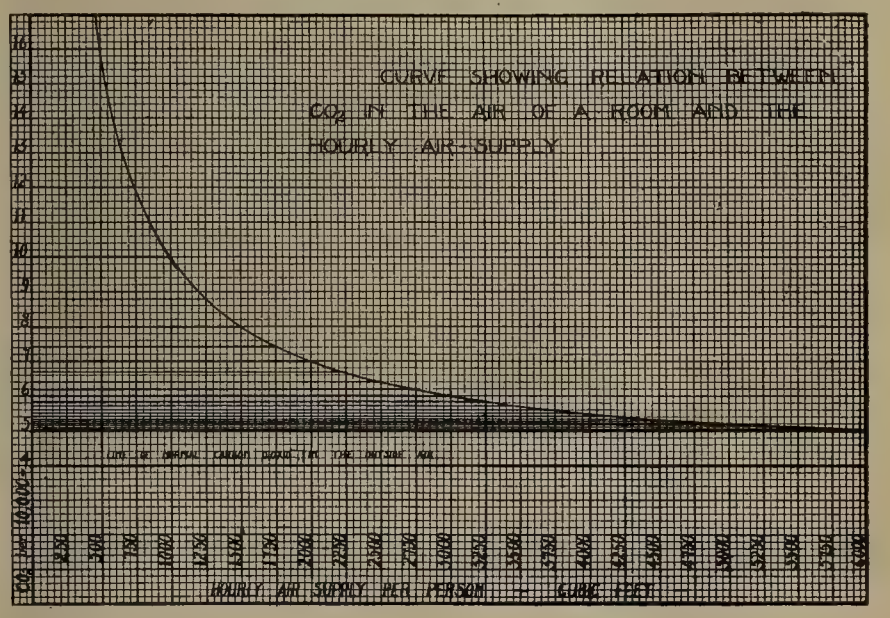


Fig. 1.

the heated air as necessary and let in the cold air, as the case may be. The practical results of deck sash ventilation are highly variable. The openings may act as either inlets or outlets, and are liable to change with every shift of the wind. They are thus liable to demand constant supervision. That trains running at high speed with the deck sashes open generally receive a fairly large quantity of air is beyond question; but downward draughts are liable to cause discomfort and the irregular action to determine unreliability.

An average of 153 determinations made by Dr. Crowder in cars without ventilators, with open decks, and with doors and windows closed, show 7.19 parts of carbon dioxide per 10,000 and an average hourly air supply to maintain this ratio of 283,000 cubic feet. The average number of people in the car was 15 and the proportion of decks open varied from one-fourth to all of them. The determinations were made at the breathing level. Observations under the same conditions but with deck sashes closed as well, showed a proportion of 8.33 parts per 10,000. With windows and deck sashes open the amount of carbon dioxide becomes practically the same as in the surrounding air. Therefore the problem of summer ventilation is one to which little attention need be paid, other than keeping out cinders and dirt, for the volume of air admitted is so great as to take away all trace of contamination.

Exhaust Ventilation.

Exhaust ventilation is being used very extensively at present and one of the best-known types of this ventilator is the Garland. This works somewhat on the principle of the injector and draws air out through the deck sash. Its operation, of course, is dependent on train motion. Each ventilator will remove about 15,000 cubic feet per hour at ordinary train speeds although at lower speeds its action is not as efficient. Six to ten of these ventilators are applied to each coach and as no special inlets are provided, the incom-

ing air must find its way through doors and cracks as best it may. Cars so equipped are much more comfortable than those with natural ventilation as the cold air is not forced down on the heads of passengers. The fact, however, that no special intakes are provided for the air may cause a portion of the air to enter through the upper part of the car where it would play no part at the breathing level; in other words it may be short-circuited. The results of carbon dioxide determinations of air at the breathing level show that to a certain extent this must happen since the air supplied to the breathing zone as computed from carbon dioxide determinations is considerably less than the amount which leaves the ventilators as determined by actual measurement.

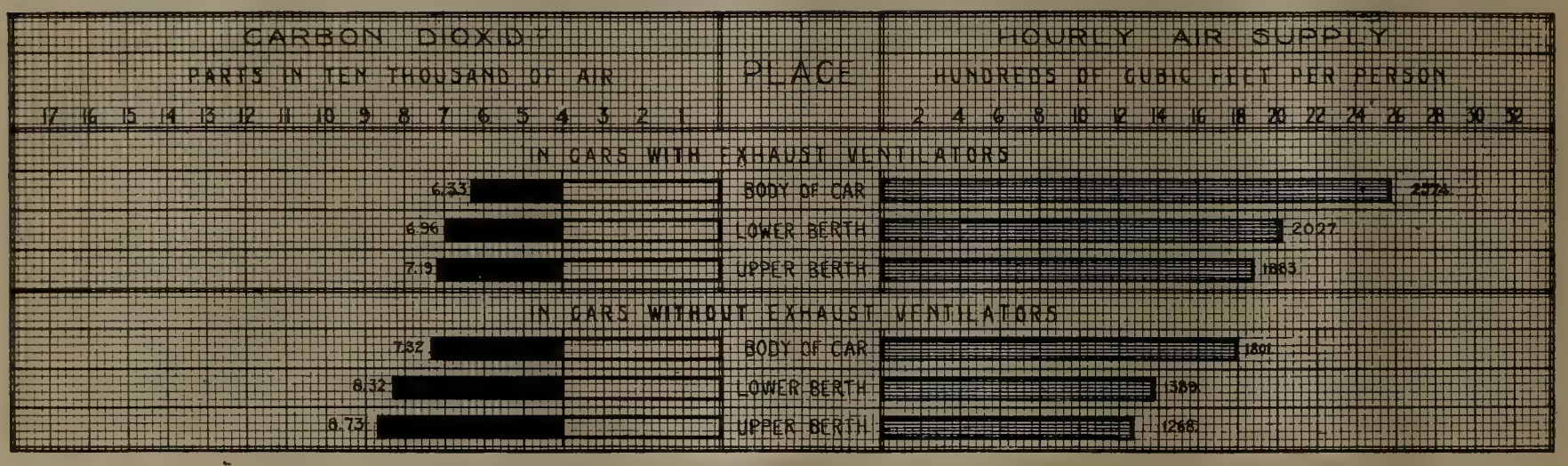


Fig. 2.

Daytime readings in cars equipped with exhaust ventilators, with all doors and windows closed showed 6.01 parts of carbon dioxide per 10,000, necessitating an hourly air supply of 38,400 cubic feet. This was the average of 115 readings and the average number of people in the car was 12.88. An average of 294 readings taken through the night in the same sleeping car and under similar conditions showed an average of 6.20 parts in 10,000, requiring 40,600 cubic feet of air per hour. The average number of people in the car was 14.88 and the readings were taken from the air in the center of the aisle.

A number of simultaneous determinations made in berths and aisles of cars without exhaust ventilators with all doors and windows closed and with about half the decks open, showed an average at the lower berths of 7.32 parts in the aisle and 8.32 parts in berths. The average at the upper berths was 8.37 parts in the aisle and 9.17 parts in the berths. In both cases the contamination of the air in the berth is greater than that in the aisle. Under the above conditions and using exhaust ventilators, the results were as follows; at the lower berths 6.33 parts in the aisle and 6.96 parts in the berth, at the upper berth 5.95 parts in the aisle and 6.51 parts in the berths. You hear many persons say, "I thing you get more air in an upper," and the popular impression is that they are better ventilated. The above results show the reverse, that the lower berth is the better ventilated. It also shows that the air contamination is nearly the same on either side of the curtain and that the curtain offers very little resistance to the passage of air. It is found that the carbon dioxide rapidly increases when a train is brought to a standstill and that the proportion in still sleeping cars is between 15 and 20 parts in 10,000.

Automatic Ventilators.

This method uses the deck window both as an inlet for fresh air and an outlet for bad air. The space of the deck sash is occupied by two openings with a space of about 12 inches between them. At the center of this space is located the deflector, a metal strip, about 4 x 6 inches, which forces the air into the forward opening and exhausts it from the rear one. This ventilator is in use on the Central of New Jersey, the Lackawanna and a number of other roads, but no tests have been made to show how efficient it is in keeping the contamination low at the breathing level. It does remove a large amount of air but it is very probable that a greater part of it is taken from the upper part of the car and it is probably not as efficient as the Garland type.

Pennsylvania System.

The Pennsylvania began experimenting with its present system about ten years ago and considerable work has been spent in improving and perfecting it. It is entirely different in principle from other ventilating systems in use and follows more closely the general idea of indirect ventilation as applied in buildings. Air is scooped in through hoods located at diagonally opposite corners of the car, conducted downward through vertical pipes to ducts which run underneath the floor throughout the whole length of the car. The heater pipes are incased just above these ducts and the air in passing into the car passes through these heater pipes to a pipe under each seat and is delivered into the aisle. There is a valve or damper in the intake pipe whereby the amount of air passing through can be regulated. Globe ventilators are placed in the roof which remove the foul air and complete the chain of circulation. The system is easily able to supply 1,000 cubic feet of air per person when the car is completely filled. While the operation of this system is to a large extent dependent on train movement, it does provide a circulation when the train is standing still because of the fact that it provides a natural circulation, the cold air entering at the bottom and passing out through the top. When the train is at a stand still it is said that this system provides about one-third of the air necessary for a crowded car.

But little has been done along the lines of forced draughts by mechanical means, although it has been used with some success where electric power is constantly on tap. It is not necessary when trains are moving at the usual rates of speed but it certainly would be of great benefit in sleepers which often stand on a track for three or four hours at a time. As stated above, the proportion of carbon dioxide under such conditions ranges between 15 and 20 parts per 10,000. The Pennsylvania system is the logical one in principle and it certainly is one to which forced draughts could be applied with the least number of changes. In the M. C. B. report of 1908, it was suggested and recommended that a limited number of cars used in such service as above, could be equipped with blowers and maintained in that service.

General.

No article dealing with ventilation is complete which does not involve also heating, for the two are closely interwoven. A study of figure 3 shows that in general the relative purity of air in railway coaches is better than in street cars, res-

taurants and offices, but that the ventilation in the still car (not shown in figure 3) is very poor, the average probably being worse than that of street cars and restaurants. However while we think we are very sensitive as to the degree of purity of air, as a matter of fact, we are really sensitive to relative degrees of heat and cold. The following, taken from Dr. Crowder's paper, probably expresses this as well as anything:

"It was suggested, long ago, by Hermans, a German investigator, that the discomfort was not so much the chemical changes in the air as it was the thermal. Heat and aqueous vapor increase rapidly in the ill-ventilated places with many occupants, and thus prevent the usual dissipation of body heat to the surrounding air. In experiments performed at the Institute of Hygiene in Breslin, Germany, it was shown that a healthy person placed in a closed cabinet could stand, with no symptoms of illness or discomfort, carbon dioxide as breathed out by himself, up to the amount of 100 or 150 parts in 10,000, provided that the temperature and moisture were kept low. However, when the temperature and moisture were allowed to increase, depression, headache, dizziness, and a tendency to nausea were experienced. Under these conditions the normal dissipation of body heat was interfered with. The investigations presented by investigators is such as to be convincing. It seems to be established beyond any reasonable doubt that discomfort is not due to any change in the chemical composition of the air, but to physical changes only; and that to maintain a normal heat interchange between the body and the air is to avoid the development of those symptoms which are commonly attributed to poor ventilation. A certain amount of fresh air must be supplied, of course; but the most vital element of the ventilation problem becomes that of regulating the temperature of the air.

"It seems probable that one main cause of the complaint of poor ventilation in the sleeping car berth is purely psychic. We are used to sleeping rooms with walls and ceilings very far from us. In the berth they are very close. Their very nearness is oppressive. It seems as if there can not be air enough in this small space to supply our wants. The sensation is often quite independent of the amount of air supplied, and even of the temperature. The average carbon dioxide in the air of running cars rarely shows more than 10 parts in 10,000. No danger to health is to be apprehended under the conditions ordinarily obtained, even in steel cars. Overheating is the paramount evil; it is the thing chiefly to be guarded against in the effort to maintain comfort and hygiene."

The air renders two services to us—it supplies us with the oxygen which it is necessary for us to burn up in our body and it serves as a medium to carry away the heat and moisture which is given up by our bodies. Therefore, in addition to pure air we must have air which is in the proper physical condition to enable it to carry off the orders of the body.

For most passengers an average temperature of 68 degrees will be found very comfortable and 64 degrees can be stood with comfort. In the berth of sleeping cars 50 degrees is a comfortable and healthy temperature. The problem in the railway coach is to be able to control the heat quickly. The two systems of heating in common use on railway passenger cars are steam and hot water and although many improvements have been made in various devices of this nature, it still remains a difficult problem to quickly and effectively regulate the heat by this means alone. Regulating the amount of heat by varying the amount of air passing in, is the general method employed in heating many large halls and this should be the logical method of effectively heating the passenger car. It should be even more feasible for the passenger car, for its heat cannot be controlled and regulated by means of opening windows, such as is the case with large halls. Arranging the heating system in multiple units with separate control is an effort from the opposite side of the question; instead of changing the amount of air passing over the pipes, the number of heated pipes around which the air circulates is changed. Of course, if it were possible to add to this heating system an automatic thermostatic control, the heat might still further be controlled. However, it does not seem that thermostatic control would be practicable for passenger cars. The regulation of heat to satisfy the occupants of each seat or section would be a long step ahead and the only system which would admit of this development at present would be the Pennsylvania or a similar system. The only objection to the latter system is that the air is dried before entering the car.

The most efficient ventilation is that which renews the air without perceptible momentum, and gives a steady even current of air. On the other hand the amount of air supplied to the car can be so great that the expense of heating it will be out of all proportion to the benefits derived. As far as keeping the air pure is concerned, the exhaust system of ventilation is quite satisfactory. The present problem, however, is to supply air and to heat it in such a manner that it will carry off the heat and oder of the body and leave it in a comfortable condition.

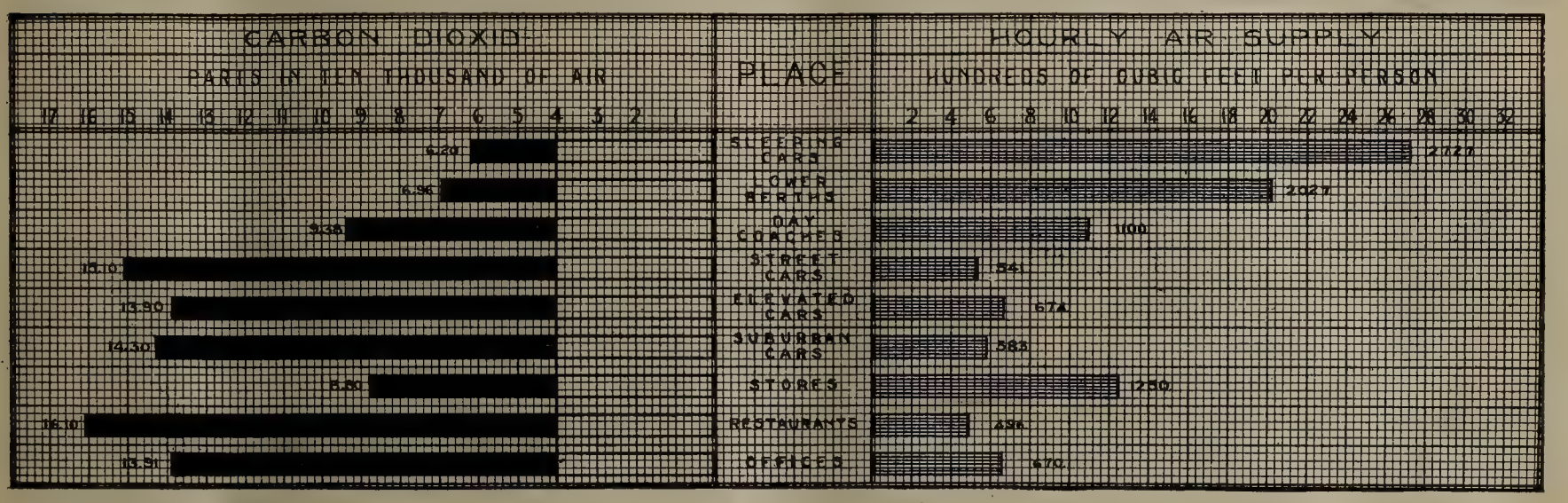


Fig. 3.

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The Chicago Great Western is one of the latest roads to establish a bureau of safety. A general executive committee has been appointed and sub-committees are to be appointed on each operating division in which the operating, mechanical and engineering departments will be represented. Local committees are to be appointed and an effort will be made to find dangerous spots and forestall accidents.

Carbondale Roundhouse, D. & H. Company.

The Delaware and Hudson Company is just finishing the construction of a round house at Carbondale, Pa., for the housing of its Mallet locomotives, and has made a number of other improvements greatly enlarging the facilities and bettering the conditions at this point. Carbondale, in the heart of the anthracite coal fields, is the division headquarters of the Pennsylvania division and its principal yard point, from which an extremely heavy tonnage goes out daily both to the north and to the southward. The new Mallets are employed to bring in shipments from the lower portions of the division, but especially are they effective in the pusher service to the summit of Ararat, north of Carbondale.

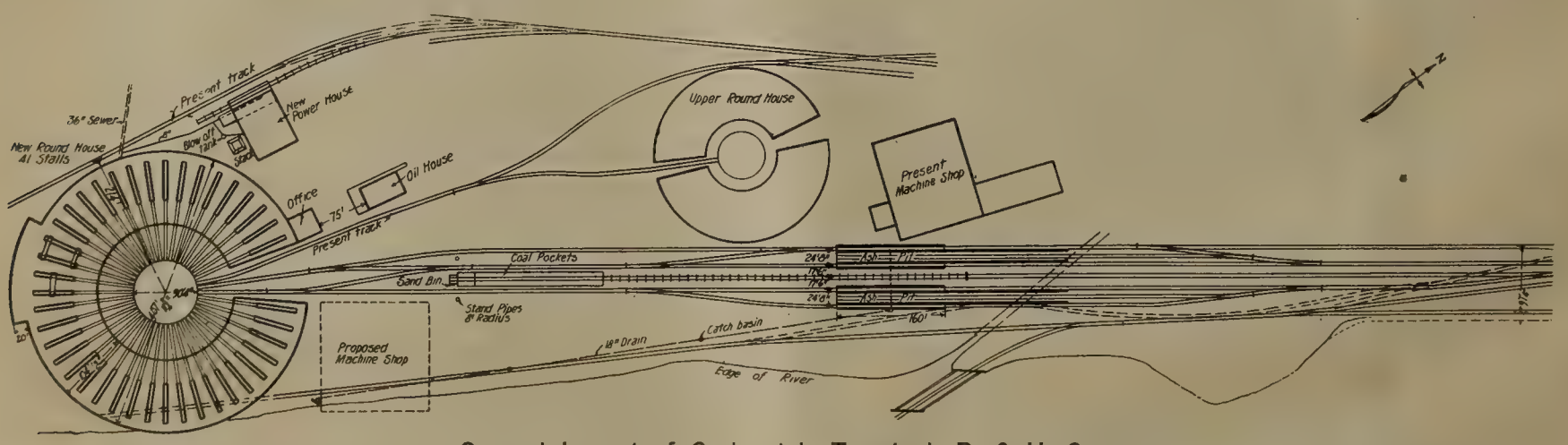
Until the recent improvements, the shop facilities at Carbondale consisted of a machine shop, car repair shops, coaling station, etc., and two round houses, one built about 1884, and the other a larger one of more recent construction, but neither of sufficient length of stall or turntable capacity to permit their being used for housing the new power equipment secured to the increasing amount of heavy traffic. This class of locomotive is amply provided for, however, in the new roundhouse located south of the present machine shops between the local freight yard and the Lackawanna river, and over the site of the older of the two original structures, the south roundhouse, which was torn down and removed during the progress of the new construction this season. To provide the necessary space for this building and the other improvements, the car repair shops are now all located on the east side of the river, the old ash pit is removed and two new double pits built a short distance from the present machine shops and near the northern approach to the new engine terminals. Also a portion of the old classification yard was taken up, a rearrangement of portions of the trackage in the yard being contemplated.

The new structure is a forty-one stall house, the inner circle having a diameter of 199 ft. 8¾ in., the outer diameter being 407 ft. 11¾ in., giving a stall depth of 104 ft. 1½ in., adequate for the largest locomotives in the service of this company, or contemplated for this division. The foundation and substructure is of concrete, the concrete extending to the top of the water table at a height of four and one-half feet above the elevation of the finished floor. The superstructure is of brick with steel columns and roof girders, provision having been made in the plans for a concrete protection encasing the steel work. The roof, supported on the steel structure by heavy wooden purlins, is constructed of two-inch matched spruce sheathing over which is placed a five-ply slag covering.

View of Carbondale Roundhouse Under Construction, D. & H. Co.

A commendable feature of the design is the generous provision made for natural light, a very large percentage of the wall space being made of windows, each stall having approximately four hundred square feet of window area in the outer wall in addition to the windows and louvred openings in the clere story. The wall space under the large windows is taken up with a reenforced concrete slab carried upon projections from the piers supporting the brickwork, in such a manner that both this slab and the window series above it are practically independent of the roof supporting structure, eliminating as far as possible danger of damage to the general structure should an engine run beyond the pits into the outer wall.

Three drop pits are provided, two for pony trucks, and one for the drivers, while directly to the rear of these drop lean-to for machine tools which is 20 ft. deep and extends along the width of five stalls. This lean-to will have a standard shop floor, but the roundhouse proper will be floored with vitrified paving block laid on a 5-in. concrete base with 2-in. sand cushion. This floor will be laid with proper slopes towards catch-



General Layout of Carbondale Terminal, D. & H. Co.

basins, of which there are three to each stall, these in turn communicating by vitrified tile drains to the main drainage conduit and thence to the main trunk sewer leading to the river. This conduit is reenforced concrete, and receives also the roof drainage, this being carried in cast iron conductors to the floor line, and in tile lines below the floor. The brick floors

Attached to the roundhouse is a rest house and locker room for the engineers and trainmen, and the upper stories of this same building will serve as offices for the master mechanic and his supervising force. This building has concrete and brick walls, closely following the lines of the roundhouse design, and will be completely equipped for the convenience and com-

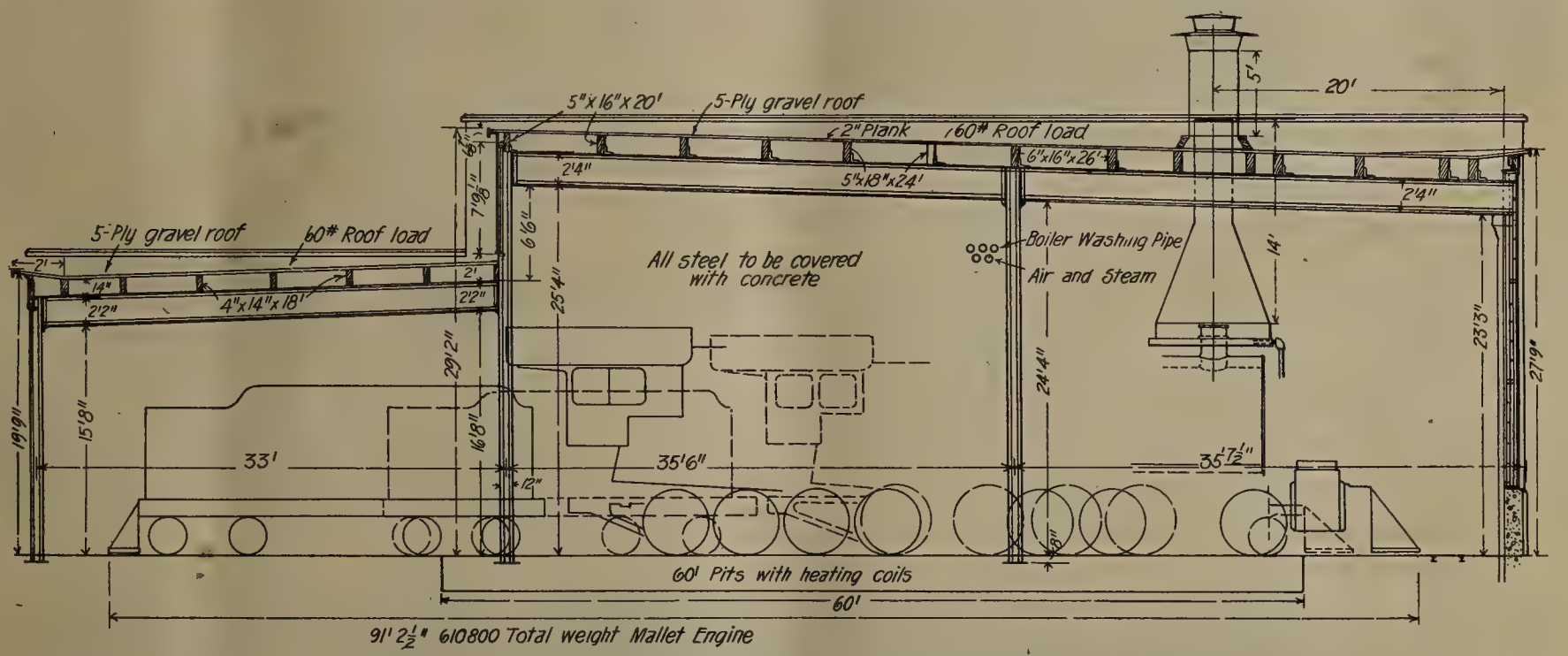
End of Carbondale Roundhouse, Showing Partially Completed Rest House, Oil House at Right.

are arched slightly between the rails of the tracks to the pits, but laid level between the rails of the 24-in. track, which, to facilitate repairs, follows the entire circumference of the outer circle between the end of the pits and the outer wall.

The cast iron smoke jacks used were made by Paul Dickinson, Incorporated, Chicago. The building is heated by a direct system with coils along the pits and walls, the mains being carried in the concrete conduit around the inner ends of the engine pits. The boiler washing system was installed by the National Boiler Washing Company, of Chicago, the mains of this system, together with the air pipes, being carried on supports suspended from the steel roof girders, with drops at every other column.

fort of the employes while at the same time providing for the expeditious handling of the business of the department.

The oil house provided is a two-story reenforced concrete structure with brick exterior walls above the second floor, but with concrete floors and roof, all windows being protected by heavy wrought iron shutters and the doors all tin-lined. The



Section of Carbondale Roundhouse, D. & H. Co.

building is surrounded by a platform on two sides and contains a very complete system for oil distribution furnished by Gilbert & Barker.

Near the roundhouse is located the new power plant, which is housed in a concrete and brick structure approximately 66x 90 feet in size, with roof of construction similar to the round-

Inner Circle, Carbondale Roundhouse, D. & H. Co.

The roundhouse is served by a ninety-foot, cone-roller center turntable made by the American Bridge Company, and equipped with a Nichols electric tractor. The turntable is mounted on a reenforced concrete foundation sunk to hardpan, and the pit is walled and paved with concrete.

house, supported on steel girders. The boiler room at present contains 800 H. P. of Babcock and Wilson boilers, with foundation space provided for double this capacity in the present building, while for future needs, ground space is reserved for the extension of the entire building to the north. The boilers

are served by a reenforced concrete chimney built by the General Concrete Construction Co. The engine room adjoining the boiler room contains the air compressor and blower equipment, with an ample capacity traveling crane; while in the pump room below is installed the general pumping equipment and the tanks and equipment incident to the boiler washing system. All the floors in the power plant are of concrete or reenforced concrete.

Fuel for the boilers is delivered to the bunkers at the powerhouse by gravity from hopper cars spotted on the trestle over

Ash Pits Under Construction, Carbondale Terminal.

the bunkers, and the ashes are handled by special equipment from the tunnel below the fireboxes to empty cars on this same elevated track. For coaling engines the new coaling tipple of large capacity is constructed of wood on concrete foundations, the light grade of the long trestle approach to the bins greatly facilitating the ease of placing cars over the bins. Special measuring pockets will be used for the coal. Sand storage bins with drying house will be reached by this same elevated track.

The water supply and fire protection are afforded by the city system.

Construction View of Coaling Plant, Carbondale Terminal, D. & H. Co.

The work was done by G. E. Scott, of Pittsburgh, Pa., under the supervision of V. Z. Caracristi, consulting engineer for the Delaware & Hudson Company.

The United Car Co., with offices in the Commercial National Bank building, Chicago, which has recently been organized, has purchased the entire plant and equipment of the American Car & Equipment Co., Chicago Heights, Ill., including a large erecting shop, blacksmith shop, offices, etc. It will build and rebuild cars and handle railway supplies in general, making a specialty of steel underframes and tank cars. C. H. Thomas is president of the company.

A railway supply salesman with ten (10) years' experience would like to represent manufacturers in Chicago and the West. References. Address W. C., care Railway List Co., 431 So. Dearborn St., Chicago.

BUSTING THINGS UP.

There was a fellow got a hunch
That he was strictly "It,"
Just to get even with his boss
He quit.

The boss he bore it wondrous well,
He never wailed or moaned or swore;
But said, "As you go out don't slam
The door."

The other boys about the place
Did not go moping much that day.
They laughed and said good-bye, and drew
Their pay.

He thought: "They do not realize
That I have left them to their fate.
So much the better; let them laugh;
But wait!"

And then he ambled down the street
And confidently told the town:
"Now, fellows, watch and see the boss
Fall down."

Somehow or other, things went on;
The business did not go to smash;
The boss went smiling as he grabbed
The cash.

And every day the fellow met
Some friend who didn't know he'd quit,
And didn't care, and wasn't sore
A bit.

It rather stunned him that the world
Went booming on through day and night
As well as when he used to keep
It right.

Somehow there isn't any man
For whom the whole creation squirms;
And good men cluster round a job
Like germs.

And when you up and leave your place
And think the whole blame works will quit,
The joker hollers, "Tag, old man,
You're it!"

The world goes plugging, plodding on,
As unconcerned as it can be;
If you are mentioned some one asks,
"Who's he?"

—*St. Paul Dispatch.*

WORKMEN'S COMPENSATION.

By O. W. Middleton.

The relation existing between employer and employee is one of the perplexing questions of the day which has grown in magnitude as our industries have developed in size. Strikes and labor difficulties are in a measure an indirect effort on the part of employees to be reckoned with as men, not as mere units of work, and with the growing distance which exists between an employer and his men, this becomes more and more difficult to do. One of the factors which has aggravated the labor question is that if by chance the employee is cast into the scrap heap by a bodily injury, he may expect little or nothing from his employer and in the past this has been only too true. Therefore any plan which to a certain extent relieves the worker of an uncertainty which he knows he may meet and which he is all too poorly prepared to meet, should better the relations between him and his employer.

During the past year or two much active interest has been taken in this country in the matter of employers' liability and workmen's compensation and at the last session of Congress a joint resolution was passed authorizing the appointment of an Employers' Liability and Workmen's Compensation Commission to make an investigation of this subject and to submit a report to Congress through the President. This committee has been taking testimony since May of the past year and is composed of the following members: Senator George Sutherland, chairman; Senator George E. Chamberlain; Representative William G. Brantley, Representative Reuben O. Moon; W. C. Brown, president of the New York Central; D. L. Cease, editor "The Railroad Trainman," and the secretary, Launcelot Packer. The railroads of the country have been represented before this committee, by a committee of twenty-one which has been chosen from the counsel of roads in all sections of the country. The recommendations of the federal committee will be mentioned later.

The railroads of this country should be and are, we believe, tremendously interested in accident prevention and workmen's compensation, for the proportion of accidents in this one industry is startling. It is a question which appeals especially to the operating and mechanical departments because it is in these departments that the greater number of accidents occur. A comparison of the railway employees killed and injured in various countries, together with the ratio to the number employed is shown in Table 1.

Countries.	Injured.	Killed.	Number of employees to 1 injured.	Number of employees to 1 killed.	Number of employees.
Argentina	320	88	258	928	82,670
Austria	1,455	106	160	2,205	233,726
Belgium	611	54	113	1,380	69,129
British India	612	375	786	1,282	481,109
Canada	1,015	217	118	552	119,845
Denmark	19	11	588	1,017	11,187
France	576	278	517	1,068	296,887
Germany	1,498	636	431	1,016	646,426
Hungary	215	108	496	988	106,726
Norway	12	2	340	2,125	4,251
Prussia	916	452	485	984	445,076
Russia	2,209	544	261	1,180	760,452
Sweden	148	36	250	1,031	37,123
Switzerland	1,467	37	26	1,071	40,031
United Kingdom	4,250	430	134	1,351	580,953
United States	77,334	3,568	19	421	1,502,944

Table I—Comparison of Casualties in Various Countries.

These are five-year averages in each case except that of the United Kingdom, which is a fourteen-year average. It will be noted that in the United States one employee in every 421 is killed, which shows a relative casuality record about three times as great as most countries and five times as great as Austria, where but one employee in 2,205 is killed. During the year 1910 a more stringent law regarding the reporting of accidents was passed and the report of the Interstate Commerce Commission for the year ending June 30, 1911, which is the first report under the new law, shows 3,602 employees killed and 126,039 injured. Over thirty-five hundred killed in one industry—that would make quite a fair-sized town—perhaps as large as the one you live in. Out of this number there were 439 killed and 79,239 injured in "industrial" accidents in shops and elsewhere. Thus it will be seen that the proportion killed in shops is low, but it should also be remembered that dangers there are proportionally less. Not so with the injured, however, as about two-thirds of these are credited to the industrial end, although it must be conceded that quite a number of these injuries are of a minor nature. But what about the man who is injured and disabled? He is temporarily or permanently thrown on the junk pile. He is given first aid and medical attendance but if he attempts to collect damages, he has to settle for a small sum or fight it through the courts, and statistics show that in the latter event about 30 per cent of the money expended actually reaches the victim. There is an old story about a workman employed on building construction, who was injured in a fall. He was soon hustled into an ambulance, but not too soon for a contingent fee lawyer to be on the job and get authority to start a suit for damages for him. About four months later this lawyer called at the house and said: "Well, I won that suit and got an award of $1,500;" then he handed the man $500 and a receipt for $1,000. The workman looked dissatisfied and surprised, whereupon the lawyer said, "Well, what's the matter, don't you think I won a good case?" "O, yes, you won a good case, all right, but I was just wondering which one of us fell off that building."

The general plan carried out by industrial concerns at present, which have no other plan of compensation, is to insure themselves against damage suits in some casualty company making a specialty of this business. In case of an accident the employer furnishes first aid and then the case is turned over to the casualty company which endeavors to settle the claim for as small an amount as possible, or prepares to defend the damage suit. It is a business proposition with the casualty company to settle this case for the least amount of money possible; it has no scruples in threatening and browbeating the victim or his family to settle at its figure. If he carries it to court, the trained legal machinery of the company is brought against him and if he does get an award, it is less than a third of what the employer had expended for protection through the casualty company. The employee on his part, or his family if he is killed, knows that he is not dealing with his employer but with an agent which his employer has paid for protection, and he will deceive and get the best of this agent if it is possible. The employer regards it more or less as a business proposition to kill his men as cheaply as possible. So the employer and employee are pushed farther apart.

The Employers' Liability Commission of Illinois recently made an investigation of over 5,000 accidents, 614 of which were fatal. The families of 214 of these victims received not a cent for the loss of the man who had supported them. Over a hundred suits were still pending in court, twenty-four cases had been settled in court, and 281 families settled with the employers. In the average amount received for death claims in the various occupations it is creditable to the railways that skilled railway employees stood first with about $1,000, while railway laborers were third with $617. But out of this must come lawyer fees and the remainder will not save a family from being wrecked in a short time, unless it is possible for the widow to find employment of some sort. One of the self-sustaining, self-respecting units of society has been broken up. Who pays the bill? Certain members of the community. This is the work that our in-

creasing number of charitable organizations are doing in part; this is the work that our poorhouses are doing. The fact that certain members of a community must accept the support of charity is not tending towards democracy in this country and a better understanding between employer and employee.

As a general proposition the railways take care of the interests of their injured, and deceased employees in better shape than most industrial concerns. Notable among roads which have been doing this is the Pennsylvania, which has a mutual pension and relief fund, the administration and deficit of which is borne by the company. On the Pennsylvania proper, there was paid from the relief fund, during the month of June, 1911, $132,186. Of this amount, $43,301 was paid to families of members who died, and $88,885 to those incapacitated for work. The total amount paid out on the Lines West for the same period was $52,122. That the system is satisfactory, is indicated by the fact that a very large percentage of employees are members. Incidentally, it might be said, that the Pennsylvania is a leader among American railways; its experimental work is of the most advanced kind and its employees are satisfied.

Employers' liability and workmen's compensation are simply two different angles of the same question, and the important subject is the compensation of workmen. In connection with employers' liability two of the terms which have played important parts in legal discussions, are the "fellow servant" and "assumption of risk" doctrines. These features have made the law a protection to the employer only and are relics of the days, when the men at the head of a factory or shop were pioneers in the business. Briefly stated the "fellow servant" clause in law holds that the employer is not liable for damages, when an employee is killed or injured, as the result of negligence on the part of one of his fellow workmen. The "assumption of risk" doctrine holds that inasmuch as a man is free to choose his occupation, he enters a certain field of employment at his own risk. There are industries in which a certain number of accidents are unpreventable, through the nature of the work, and therefore if he chooses to enter these occupations, because of a higher financial remuneration or for other reasons, he assumes the risk. That is, if a man loses an arm by getting it drawn into gearing, the employer's attitude is, "You knew that this might happen; therefore, it is not a thing in which I am responsible or concerned." These two defenses together with that of contributary negligence on the part of the employee have been taken from the employer in practically all foreign countries, and the attitude now is that the employer in creating shops, locomotives and cars, has set a more or less dangerous force in motion, for which he is responsible.

The United States is the last great country to take up this subject; it may be that this bears some relation to our high proportion of casualities. Practically all foreign countries have abandoned the old employers' liability system and have adopted various forms of workmen's compensation, Germany and England being the two which have been most prominent in this connection. The Germans abolished employers' liability laws, similar to ours, over twenty-five years ago and compulsory accident insurance and compensation is in the hands of associations of employers organized into groups, the group to which an employer belongs being determined by the amount of natural danger connected with his plant. In the accident feature the employer contributes 83 per cent, the workers contribute 17 per cent, while the government contributes a sum which approximately pays the expense of administration. The fact that both sides interested are contributors has worked for better relations between the employer and employee, and this in connection with an excellent system of shop inspection has worked to decrease the number of accidents. In the sickness feature which is also compulsory in this country, the employer and employee contribute equally. Of the total sum expended for insurance in Germany 77.7 per cent is paid as compensation, 12.8 per cent is paid for administration, and 9.5 per cent goes into the reserve fund. This 77.7 per cent is more than double the amount which reaches the injured worker in this country where it will be remembered that only from 25 to 40 per cent of the money expended reaches him. The German system in case of death, pays a pension equal to 67 per cent of the yearly wage of the deceased and a pension of 67 per cent of the yearly wage in case of total disability, which is increased to 100 per cent if the regular aid and attendance of another person is required.

The plan which has been in effect in England up to a recent date has been quite different from the German plan; that is its adoption was not compulsory and if the employer choose to come under its provision, he insured in private companies as before, although he might join with others in a mutual indemnity society. However, if he did not come under its provisions, the law took away all defenses from the employer except that the accident was caused by wilful misconduct on the part of the employee. For death a sum equal to three years wages is paid; for total and permanent disability, a pension equal to 50 per cent of the wage. On December 15 just past, Parliament passed a compulsory sickness and unemployment insurance bill, which is even more advanced than that of Germany, inasmuch as it also provides unemployment insurance. Under its terms the employer contributes about 66 per cent, the worker 11 per cent, and the government contributes the remainder. Sickness allowances will be $2.50 a week for three months and $1.25 a week up to the end of six months. The compensation for permanent infirmity is $1.25 per week. The act covers all trades and businesses, and the workers' contributions are to be deducted from his wage.

Insurance against unemployment applies only to the building and engineering trades, which are most liable to fluctation. In this feature the employer and the worker contribute equally, and the benefits are $1.50 and $1.75 per week, but no payment is to be made in case of a strike. This insurance feature is an entirely new departure, and will be watched with interest.

Other European countries have various forms of compulsory accident insurance. Norway has a system of state insurance in which under wise and careful management only about 11 per cent, is spent for its operation. This is the best example of state insurance in the world but even this ran short at one time. In Italy the employer has three options: a State fund, an insurance company, a mutual association or a private employers' fund. Sweden has optional State insurance. Austria-Hungary has compulsory insurance in associations of employers within prescribed districts, thus differing from the German plan which groups employers according to their risks. France has a state insurance institute, with a capitalized reserve which competes with private companies. The employer is responsible to his employees for a certain sum but he may substitute State insurance or a recognized insurance upon payment of the premium.

The following are the compensations paid in the above countries: Norway, for death, a pension of from 20 to 50 per cent of the yearly wage; for total and permanent disability a pension of 60 per cent. Italy, for death, a sum equal to five years' wages and for total and permanent disability a sum equal to six years' wages. Sweden, for death, a pension of from $32 to $80; for total and permanent disability, a pension of $80.40. Austria-Hungary, for death, a pension of from 20 to 60 per cent of the yearly wage and for permanent and total disability a pension of 60 per cent of the yearly wage. France, for death, a pension of 20 to 60 per cent of the

wage and for total and permanent disability a pension of 67 per cent. In all these countries payment for partial disability is in proportion to the payment for total disability, and various provisions are made for sickness insurance.

In our own country a number of private corporations have worked out efficient schemes of compensation for their employees and notable among these is the International Harvester Co. The International Harvester Co. compensates for all injuries, waiving all defense the corporation had, provided the employee accepts the compensation. From the date of the accident the company pays 50 per cent of the average wages for a period not exceeding two years, and if the worker is permanently incapacitated he is paid a pension of 8 per cent of the death benefit. The maximum death benefit is $4,000 and therefore, the maximum pension is $320 per year. The men contribute but a very small amount to this fund, the maximum amount being 10 cents per month. The company claims that this system is costing it three or four times what it did under the old system of settle or take it to the courts.

At present eleven states have adopted legislative measures on the subject of workmen's compensation, namely:—California, Illinois, Kansas, Massachusetts, New Hampshire, New Jersey, New York, Nevada, Ohio, Wisconsin and Washington. Maryland and Montana have compensation acts applying to particular industries. Fourteen states have abolished the "fellow servant" rule and seven or eight have modified the other common law defenses of the employer. In only one of these states has compensation been made compulsory. This is in the state of Washington, and the supreme court of that state has declared the act constitutional. This law covers a large number of so-called hazardous employments, and when the worker is employed he waives the right to sue and is compelled to accept the compensation provided for. This compensation varies from $1,500 to $4,000 in case of death or total disability. Injuries are compensated at about 60 per cent of the loss of wage which the employee sustains. The plan is a mutual one; the employer contributes 4 cents per workday to the first aid fund and he is also authorized to deduct 2 cents per workday from the wage of the employee.

New Jersey during the past year has passed an act, which gives the employer the option of coming under the provisions of the workmen's compensation features or if he does not so elect, practically all the usual defenses such as "assumption of risks" are removed. The compensation under the act is as follows: for temporary disability, 50 per cent of wages; for total and permanent disability, 50 per cent for 400 weeks; for death compensation depends on the number of actual dependents, the maximum being $10 per week for 300 weeks.

New York legislation on this subject was declared unconstitutional during the spring of 1911. Under the New York act the injured workman had the right to choose the compensation system, or to take the matter to the courts. If he elected compensation, the employer had no defenses and the compensation during disability was half wages for not more than eight years, and three years' wages for the dependents in case of death.

Wisconsin has passed an act similar in many ways to the New Jersey act, giving the employer the option of coming under the compensation provisions, but removing all defenses if he does not. The law provides for a compensation of 65 per cent of the average wage in case of disability. Other state legislation has followed along similar general lines.

The federal Employers' Liability and Workmen's Compensation Commission has recommended a general plan of legislation to the present Congress along these lines:

"The law to provide for payment of compensation by interstate carriers engaged in interstate commerce to employees sustaining injury by accident while engaged in such commerce, except in cases of wilful misconduct to be hereafter specified.

"The compensation to be paid by the employer directly, and not out of a general fund created by any form of taxation.

"That the law shall be in form compulsory, and not subject to election by either employer or employee.

"The remedy provided by such law to be exclusive of any common-law or other statutory remedy.

"To apply to all accidents resulting to the employee while in the course of his employment, except those where the disability continues for a period of two weeks or less, the employer, however, to furnish medical and surgical assistance to an amount not exceeding $200.

"The amount of all payments to be based upon a percentage of the wages received by the injured employee, at the time of his injury. Payments of compensation to be made under the law shall be made periodically, and not in lump sums, with however, appropriate provision for commutation at any time after a lapse of six months upon application to either party.

"The amount of payments to be limited to a minimum and maximum sum, and not to continue beyond a specified term of years, to be hereafter fixed. The question as to whether or not this limitation shall apply to permanent total disability is left open.

"All claims arising under the law shall be nonassignable and exempt from levy.

"In case of death, payments to be made to dependants, including alien dependents.

"All claims under the law to be made preferred lien.

"Whenever any railway company and its employees have agreed or shall hereafter agree upon a plan of compensation which is as favorable to the employees as the provisions of this law, such plan may be substituted for the law, provided that wherever in any such plan the employees contribute to the compensation fund the plan shall contain beneficial provisions, in addition to the schedule of payments, equivalent to such contribution."

The question of administration features of the law has been left open to future determination, and it will be seen that only the very general features of the law, have been decided upon.

There has been much discussion indulged in by the legal profession, regarding the constitutionality of employers' liability and workmen's compensation legislation and the basis of the decision of the courts which declared the New York act unconstitutional, rested on that amendment of the constitution which says "No person shall be deprived of life, liberty, or property without due process of law." The view is held that in contributing to the compensation of workmen injured, without regard to cause, the employer is thus deprived of a certain amount of property without due process of law. Others hold the view that such legislation is in accord with the spirit of the constitution, which is given us "to establish justice, insure domestic tranquility and promote the general welfare." The discussion of this phase of the question is a legal one, and will not be gone into here. However, it is probable that legislation of this character if carefully and wisely framed, will be upheld.

An attempt has been made in the foregoing to give a brief outline of the features of this question together with a sketch of what has been done up to the present, in our own and other countries. Workmen's compensation generally has proved successful in European countries, and has resulted in greater efficiency for the nation. Statistics collected over a term of ten years in Germany, show that there has been a decrease in accidents causing death, total permanent disability and partial permanent disability, and this is in a large measure due to the interest in safety by both employer and

employee which has been brought about by the mutual plan of compensation. On the other hand, there has been a notable increase in the number of minor accidents, resulting in disability lasting a few weeks. This is due to the efficient manner in which accidents are reported. It is true that it is better not have the accident than to have to compensate for it. However, a certain number of accidents are unavoidable, and a system which makes compensation compulsory and an item in the cost of production is certain to result in greater care and a decrease in the number of accidents. Of course, the expense to which the employer is put for compensation means an increased cost of production, and that a slightly higher price must be charged for the product. Thus it will be seen, that workmen's compensation means a more even distribution of the cost of human wreckage on the community as a whole.

If federal legislation is enacted, and it seems certain that it will come sooner or later, most railroads will have to meet the increased expense with an increase in rates, and it is reasonable to suppose that these will be granted. It will also be noted that the recommendations of the present commission state that any road which agrees upon a plan of compensation as favorable to its employees as the contemplated plan, shall be allowed to substitute it for the law Large roads and corporations can efficiently handle a private plan of compensation, if they wish, but the small manufacturer or railroad, cannot carry out such a plan on account of the large reserve necessary. At present, several successive and heavy damage suits could easily bankrupt some concerns and if the proposed legislation results in the combination of employers into groups, it should give greater security to each.

The laws which some of our states have enacted on the subject are good, but we are in need of national legislation in order to securer greater uniformity and that all states may have equal advantages. For instance, the rates charged by casualty companies in New Jersey to employers, are now many times higher than they were before the passage of the New Jersey law, because a greater protection must be guaranteed. Therefore, the employer might find it to his advantage to move over into Pennsylvania, where there is no compensation law and where consequently insurance rates are much lower. The New Jersey law has not done away with the system of private insurance, a thing highly to be desired for efficient compensation.

A system of insurance, which consists of contributions by the employer and employee, administered by the state seems preferable to the system whereby the state issues the insurance after the manner of the private company. It does not seem that insurance issued by the state would be feasible, one reason being a tendency of powerful forces to drag it into politics. Then, too, it detracts from the interest of the employer in the safety of his plant, as he knows that his premiums are already fixed. Furthermore, it is very precarious business for the state to engage in unless it has at its command all the knowledge of private companies, for this insurance is a much more complicated problem than life or fire insurance, as claims for damages may arise years after an accident, and it is much harder to classify the risk. The German plan of banding the industries into groups and having both parties pay into a common fund, administered by the state, is the one being largely adopted today.

Optional insurance, where the employer has the choice of conforming to the provisions of a compensation act, or resorting to the regular method of the courts, is not likely to prove as satisfactory as compulsory insurance, which is recommended by the federal commission. The very fact that it would allow one of two paths to be taken, would force the employer to be prepared to defend both roads, and it is probable that he would choose to defend that which would result in the least expense to him. Furthermore, it would still continue to throw a large number of damage suits into the courts, and one of the things claimed for practical compensation is that it will relieve congestion of the courts and the expense which damage suits are at present causing. However, certain state legislation at present enacted though optional in form is practically compulsory. For instance, in Wisconsin the usual defenses are removed for the employer, who does not elect the compensation feature and so the International Harvester Co. has decided to come under the compensation feature and to drop their own private plan of compensation in this state. When an employee is hired there, unless he otherwise states, he agrees to accept compensation in accordance with the state regulations. If he does not so agree, the company will probably find him an "undesirable" employee.

This subject contains many problems which will take some time to work out satisfactorily, and even then they must be adjusted to suit the change in conditions. Although there are various plans, and theories covering it we believe that the only practical plan for workmen's compensation will be that one which brings the employers together, and which also, brings employer and employee into mutual cooperation to prevent and provide for losses in human efficiency.

SINGLE-PHASE RAILWAYS BREAK SNOW BLOCKADES.

That the single-phase system is inherently fitted for electric railways is well illustrated by some experiences that the Spokane and Inland Empire R. R., which operates a 11,000-

S. & I. E. Single Phase Train After Riding Out Storm.

volt, single-phase line in the state of Washington, has had during the last two years.

It has been found that during the winter when the steam trains, operating on routes paralleling that of the single-phase, are unable to get through without considerable delay, single-phase trains hold very closely to their schedules. The principal reason for this is that on a single-phase road the voltage is so high that it holds up to almost normal even when the motors on the locomotives or cars are drawing very heavy currents. Upon an ordinary 600 volt road when the car must "buck" snow, the current consumption is so great that the line voltages usually drop to a value too low for effective operation. On a steam road the ability of a steam locomotive to haul loads is actually reduced in cold weather because of the greater losses of heat from the

locomotive. The reverse is true with an electric locomotive because in cold weather the motors are maintained at a much lower temperature than in warm weather, hence their ratings are increased.

As indicated in the illustration the only plough used on the Spokane and Inland trains was one of the usual shield type mounted on the pilot. This has proven to be entirely effectual in keeping the line clear enough of snow for satisfactory single-phase operation.

The winter of 1909 and 1910 was one of the most severe ever experienced in that vicinity. The Spokane and Inland was said to be the only local road that maintained its regular scheduled service through this trying winter. At no time during the worst storms were its trains more than 20 minutes behind its schedule. This excellent showing was maintained even when there was a foot or more of snow on the ground and six to ten feet of it in cuts.

The illustration shows a train just after arriving in Spokane 20 minutes late after riding through a storm that completely tied up the steam roads in the vicinity. The Spokane and Inland Empire motor car shown in the illustration is equipped with four No. 132 Westinghouse single-phase motors and Westinghouse HB control.

TERMINAL BRAKE TESTING.*

By F. B. Farmer.

While having in mind the ideal of 100 per cent of brake efficiency at all times, I recognize that we can never attain it, and also that the average is far less, that the percentage varies greatly between various railways, but that we can now consistently ask for a general improvement, especially as the roads with the lower efficiency come nearer to those with the higher.

Our major and controlling limitation is the dollar. Railways are built and run for profit and the measure of gain attained is mainly dependent on the safe, expeditious and economical transportation of freight and passengers. Without safety, wrecks, loss of life and minor damages increase; without expedition, a relative term, the business goes to other roads, for "Time is Money"; and without safety and comparative expedition there cannot be economical transportation. All else being the same, the relative degree of safety is manifestly measured by the comparative efficiency of the brakes. Expedition cannot mean higher speeds as that implies less safety and higher cost per ton and per passenger mile: Hence, it is obviously dependent, in the practical sense, on avoidance of unnecessary delays. True economy, then, is in spending no more in either dollars or time than necessary to obtain a relatively high, safe and expeditious movement of traffic, but to spend that much. The problem is to determine what these expenditures of time and money should be and how to make every dollar spent, and each hour consumed, go as far as possible. It is the writer's desire to contribute a little toward this end. Freight brakes only will be considered.

As faults cannot be remedied until located, the first requisite towards repairs is to locate the defective brakes. The next is to so mark the cars as to insure the earliest practicable repairs. While the use of the air brake defect card by train-men can help much, yet experienec shows that we must depend mainly on the car men, including those in car shops and on repair tracks as well as yard inspectors.

As we seek efficient train brakes and as the standard set by law is based on the train, it is obvious that terminal brake tests of trains must be made. Stated differently, the requirements could not be met by confining inspecting, testing and repairing to shops and repair tracks.

Consideration of overtime and the sixteen-hour law, as well as expeditious train movement, demands the minimum lapse of time between that for which the crew is called and that when the train departs. Hence, a train prepared for departure should require no more brake work after the engine is coupled than, at the most, stopping a few leaks in hose couplings and making the formal test. But often today there are greater delays due to making other repairs, or the train proceeds with less efficient brakes than it should have.

To avoid this, the repairs required must be determined with arriving trains. The incoming engineer should add to the reduction required for stopping enough to fully apply the brakes, and the brakeman should await his advice that this has been done before cutting off the engine. Car inspectors should be present to make an immediate examination and to bad order all defective brakes. Such repairs as ordinary brake pipe leaks, defective hose and wrong piston travel, those requiring little time, should next be made, but cars requiring heavy brake repairs should be marked for the repair tracks.

Here is where judgment must be exercised, as perishable or other very important loads as well as empties needed at once for such lading, must not be delayed. Neither should other less important cars be held in numbers far greater than the local force can repair in a day if such force is as great as the regular amount of work, including such repairs, would keep busy. The car foreman and the yard master should consult to adjust the foregoing, but when the former removes bad order marks without repairs having been made, he should fill out and apply an air brake defect card to better insure prompt repairs at the earliest practicable date.

However, it does not follow that the repairing of defective brakes cannot be done without delay to cars which should go forward promptly. The Minneapolis, St. Paul & Sault Ste. Marie has largely solved this problem at an important terminal yard by assigning a short track in the yard for air brake repairs to such cars. With a few men and needed repair materials, such cars received in transfers are often ready for the first train out, are never actually delayed, and few of such are allowed to go forward without repairs. This is but one detail of a very comprehensive scheme of improvement in freight brake maintenance effected by this road, and it is hoped that their C. P. McGinnis, general air brake inspector, will contribute the valuable information which he can regarding this and other details coming under the subject of this paper.

As one repair point on a large system cannot maintain all freight car brakes, it is obvious that each terminal, with needed facilities, should do its share, but this does not mean that other than the outgoing test should be made on through trains at the points with small facilities. A brake well repaired will go for a long period without becoming defective, but the too common failure to do so, is due to inadequate repairs. To reduce the cost of brake cleaning by leaving cylinders and auxiliary reservoirs loose on the car is to insure leaky pipes. The same result follows if the brake pipe and retaining valve pipe are not well secured. That most serious fault, brake cylinder leakage, will develop sooner than it should, sometimes immediately after the cleaning, unless a suitable lubricant is employed and packing leathers are replaced when a good inspection and a careful test would show that they should be. The practice often followed of cleaning and testing triple valves on the cars cannot insure good work. Neither is it common practice to test hose with soap sups while under maximum pressure and remove those found porous, or to examine the retaining valve weight and clean the case and small vent port. Until these and other details are given better attention in shops and on repair tracks, it will not be

*From a paper read before the Western Ry Club.

possible to effect the economy in time and money in terminal brake testing and the consequent repairs that will otherwise follow.

The M. C. B. requirement that cars in interchange must have retaining valves should imply the maintenance of this part and its pipe by the owning road. It is not sufficient to say that the mountain road may make needed repairs at the owner's expense as this means undue delay to traffic. However, inspections show that the average efficiency of brakes is otherwise much lower on the cars of level grade roads, a condition for which there is no warrant as that of the average mountain grade road is enough below 100 per cent efficiency to justify making it the minimum.

That the regular terminal test of freight train brakes misses many of the defects which nullify the object sought in attaching air brakes, is conclusively demonstrated by the following: Within a few months competent parties made this test on several freight trains at the summit of a mountain grade, following a similar test by regular inspectors at the preceding division terminal, and out of which trains bound down this grade were supposed to leave with 100 per cent efficient brakes, based on such test. The test consisted of charging to 70 lbs., making a service reduction of 20 lbs. and rapidly examining for any brakes failing to apply or leaking off and incorrect piston travel. To show conclusively the oversights of the ordinary terminal brake test the infallible thermal brake test was made on each train at the foot of the grade. The customary plan was there followed of considering three cars with "warm" wheels equal to one with "normal" wheels; that is with a good brake. In addition to showing the results in percentage, they are given in "Tons per Good Brake," derived by dividing the train tonnage by the number of good brakes.

The first train given was a test train and had 2,501 tons. The other six were regular trains and ran from 2,252 to 2,367 tons, averaging 2,286 tons. Each train had a considerable percentage of foreign cars. No tests of or repairs to retaining valves were made:

Per Cent Good Brakes by Test		Tons per Good Brake by Test		Cars per
Standing	Thermal	Standing	Thermal	Train
97.7	68.8	42.6	59.5	61
91.0	75.0	45.0	54.6	56
100.0	60.0	40.7	67.6	58
98.1	53.7	42.5	77.6	54
98.1	52.8	43.8	81.5	53
96.4	53.5	41.7	75.0	56
88.9	67.2	46.2	61.2	55

The big returns from good brakes are mainly concealed, consisting of the more expeditious train movement they make possible and the avoidance of accidents, neither of which can ordinarily be shown in dollars and cents. Their observable expenses, consisting of initial cost, maintenance, flat and cracked wheels and delays to cars and trains for brake testing and repairs, are so readily seen and tabulated as to generally render even more obscure their great but intangible credit account. The pressing need is for a more accurate and practical appreciation of the facts, that good brake maintenance is economy and for better directed efforts toward improved brake maintenance with a minimum increase in time and money spent. In this the active co-operation of the yardmaster and the superintendent will aid greatly. Too often their efforts are directed toward showing why trains cannot be held or switching done for brake work, rather than how to acomplish the desired results with the least delay or additonal switching.

Air Brake Test Plants.

While there is no question concerning the imperative need of available air pressure in car shops and on repair tracks, it is debatable as to whether it pays to pipe yards. I believe that usually it does not. If locomotives have insufficient air compressor capacity to charge their trains without material delay, they are not prepared to handle the trains safely, economically and expeditiously between terminals. Following the plan of a brake test on incoming trains, as described, and the subsequent disposition of cars with defective brakes, will leave little need for a yard air test plant. The only safe or available time for inspectors to work on cars in yards is for a limited period after the arrival of trains and again following attachment of the outgoing locomotive. My observations show few exceptions to the foregoing.

A grave evil with many air brake test plants is the excessive amount of moisture. The ground cocks in their piping are commonly referred to as "hydrants." This should be a misnomer as it means a cock for controlling the flow of water, but it is too often quite applicable. As a brake pipe obstructed by ice is even more dangerous than an accidentally or maliciously closed angle cock (the former cannot be seen), it is enough to say that water in test plant pipes may bring about frozen brake pipes. Triple valve and brake cylinder leakage from ice are other evils which follow. Also moisture causes corrosion of brake pipes and the rust clogs strainers and feed grooves and drys up the lubrication in triple valves and brake cylinders.

The cause of water in air testing piping is the result of insufficient cooling of the air between the compressor and the storage reservoirs, often magnified by inadequate number and location of such reservoirs. It is many years since the Air Brake Association investigated the same fault with locomotives and though the difficulties in the way of obtaining dry air for the brakes is there incomparably greater, it was solved satisfactorily. However, it should be said in passing that many locomotives, even new ones, are not properly equipped and are a source of similar damage and danger. Inquiry of men using air test plants will soon disclose whether they furnish dry air, whether opening a cock will show visible moisture or moisten a surface against which the air is directed. If so, it is obvious that the remedy should be applied promptly. I venture the assertion that in comparatively few cases is dry air, free from visible moisture, available.

In seeking means for testing and repairing air brakes without loss of time in transit, extra switching or danger to workmen, the possibilities of the freight house tracks should always be investigated. Where the number of cars per day is considerable there is no doubt that the tracks should be supplied with compressed air and full advantage taken of this excellent opportunity for locating and remedying air brake defects.

In line with this idea of conserving time and switching, it is recommended that all cars in shops or on repair tracks, and having cleaning dates over nine months old, should have their brakes cleaned and lubricated. Not only will the condition of the triple valves and brake cylinders fully warrant doing this work then, but it is improbable that such cars will again be so favorably located for many months, without causing delay and switching.

This paper does not pretend to cover the subject exhaustively, but merely to point out broadly that brake maintenance is much less efficient than it should and can be, the important bearing that terminal brake testing has on it, and some of the practical ways in which a very considerable improvement can be effected and generally with the expenditure of less money and time than now often follows as the result of inadequate installation of, and superficial repairs to, air brake apapratus and, as well, misdirected and conflicting efforts in its maintenance and traffic movement.

Shop Kinks

An item good enough to publish is good enough to pay for

CHICAGO & ALTON R. R.

By R. J. McGrail.

(Continued from December Issue.)

Figure 20 is a hydraulic bolt starter. This is a very useful tool in places where space is limited. The operation of this tool is quite clear from the drawing. It can be readily

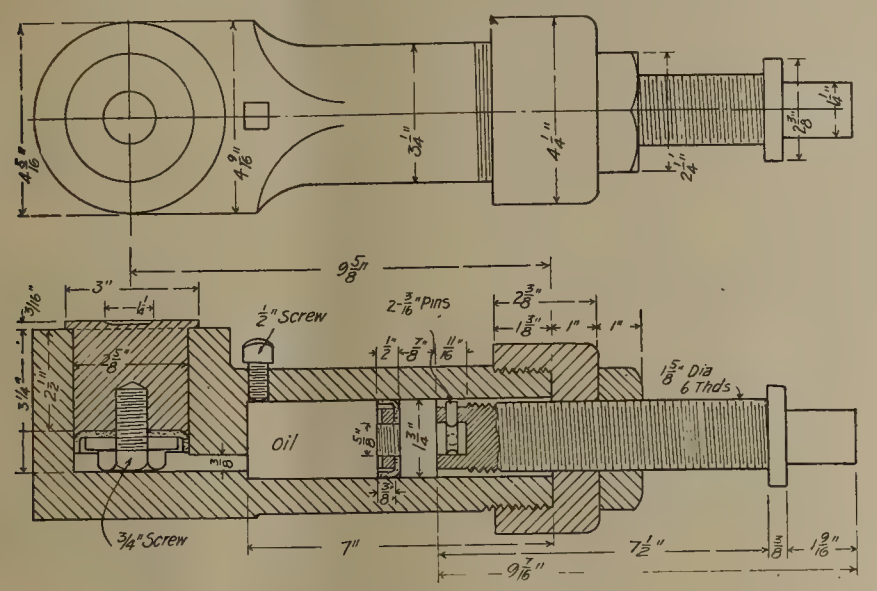


Fig. 20—Hydraulic Bolt Starter.

seen that when the screw is forced in upon the oil that a great pressure is easily exerted on the plunger, forcing it against the bolt.

Figure 21 is a tool for clamping steel tires to a boring mill. It is very simple in construction. The clamping device consists of a toothed jaw in which operates a cam which is forced in or out by a socket wrench.

Figure 22 shows a device for screwing the flexible staybolts into the firebox and also a device for holding on while riveting on the inside of firebox. These tools are shown in detail and are self explanatory.

Figure 23 shows a tool for planing the babbitt in crosshead

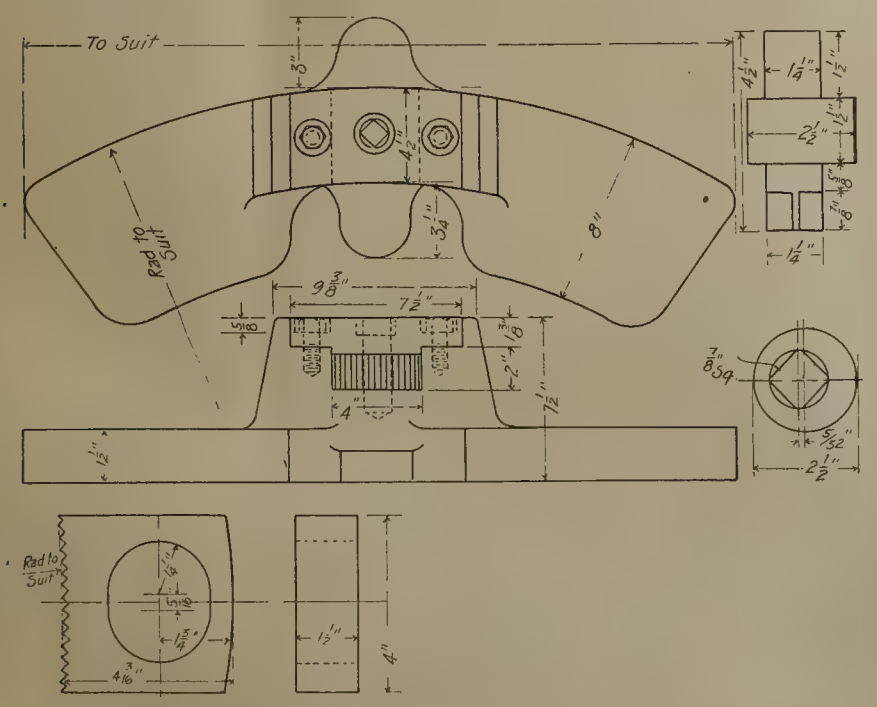


Fig. 21—Jig for Tire Boring.

slippers which makes an effective and time-saving tool, the metal being taken off with two or three strokes of the planer.

Figure 24, shows a tool for planing the babbitt out of truck brasses. It will be seen that the disc are made the same diameter as the axle and when worn can be turned around to a new cutting edge. This is a great time-saver where a lot of brasses are used.

Figure 25 shows an ideal erecting shop tool cupboard. Wrenches of all sizes are hung on two sides of cupboard. The enclosure with door on each end will be found a convenient place for air hose, air motors, long wrenches and

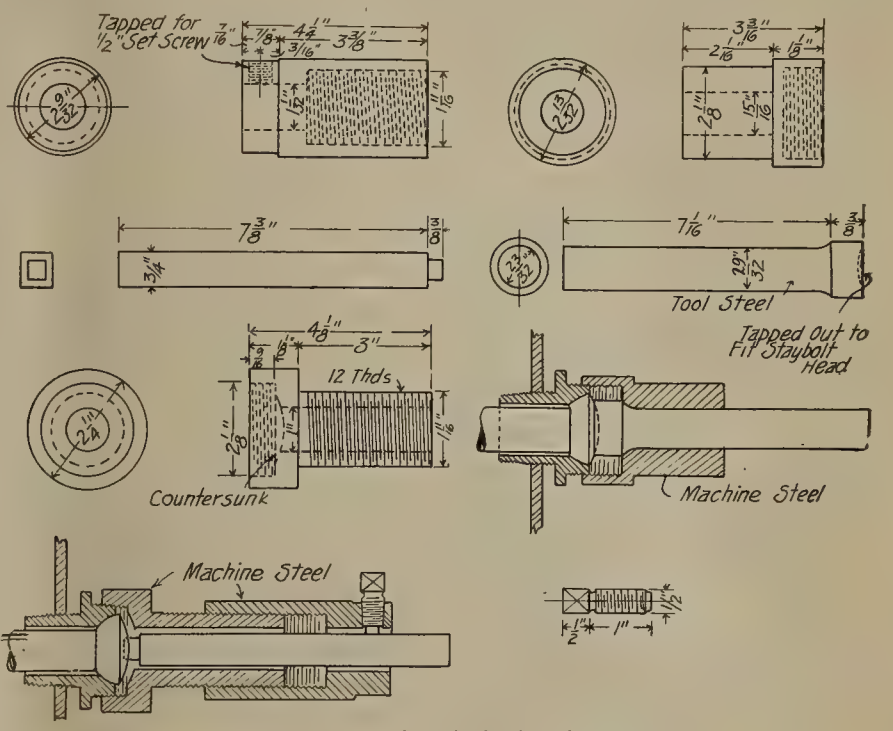


Fig. 22—Staybolt Devices.

pinch bars. The drawers are petitioned off and are intended to contain split cotters, small bolts and nuts, rough and finished, of all sizes. The small shelf on top is used for oil cans, torches, etc.

Figure 26 shows a complete washout plug equipment. The taps are spaced in consecutive numbers and the long taps are for general use. The shorter ones are used when not

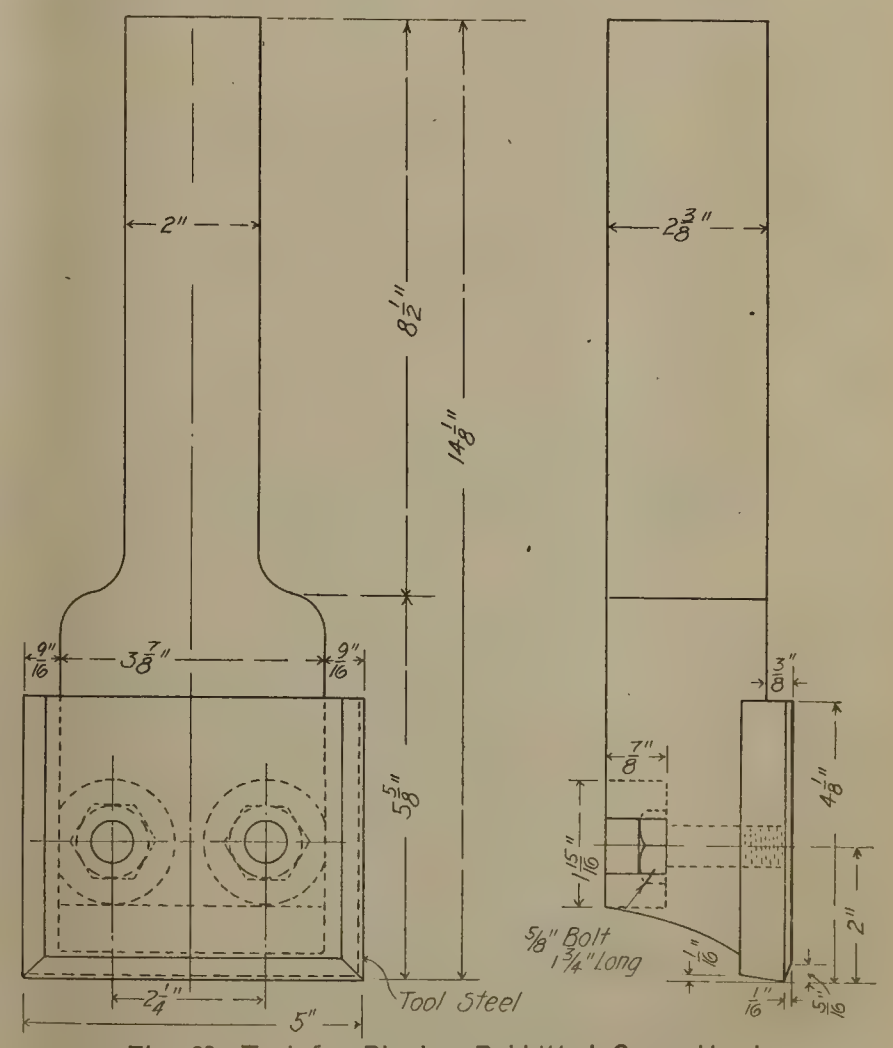


Fig. 23—Tool for Planing Babbitted Cross Heads.

convenient to use long ones in case of obstructions. Each number on gauge plate corresponds with tap. The plugs have cast numbers and when finished are kept in numbered

cupboard. The turning and threading tools are used in Fox lathe and only one cut is necessary with each. The plugs are gripped by either pneumatic or universal chuck and do not require centering. The caliper is graduated to necessary sizes and when lathe man finds stock of any size plugs getting low he merely sets caliper to required number and

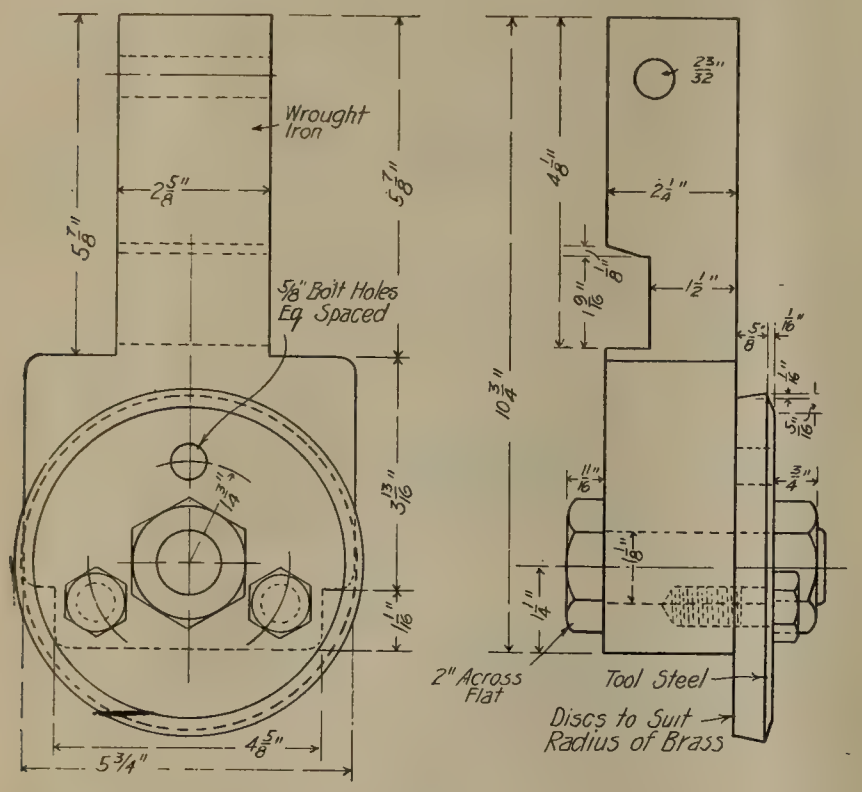


Fig. 24—Tool for Planing Truck Brasses.

after sizing first plug locks lathe carriage and turns and threads any number necessary. With this arrangement from 40 to 60 plugs can be finished per hour.

The rank of each man in the crowd depends on two things:
What he has in himself to sell, and
How good a salesman he is.

For, after all, power to do a certain thing, no matter how well, doesn't count for much unless it is joined with the ability to find out what that thing is, where the market for it is, and then is joined with the ability to trade it off to good advantage, and once sold, to continually show that power to good advantage.—Power.

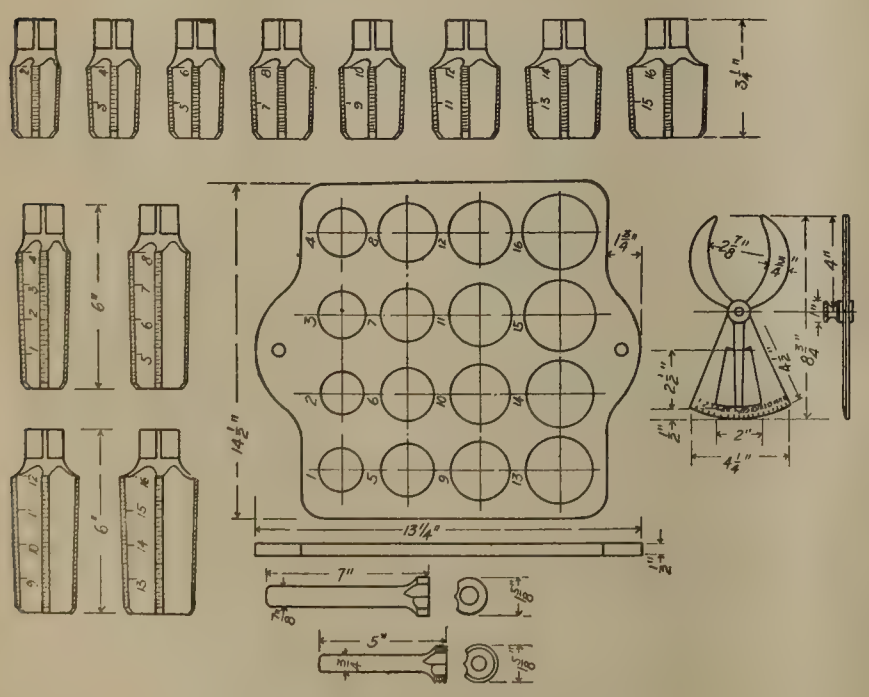


Fig. 26—Washout Plug Equipment.

NOTABLE EFFICIENCIES IN RAILWAY MACHINE-SHOP OPERATION.*

By George J. Burns.

The development of the modern locomotive has in many instances been accomplished by transgressing scientific rules and disregarding the mandates of accepted knowledge. Dogmatic instructions are often limiting. Unlike the human anatomy, the bones, muscles, arteries and nerves of a locomotive are not of the same structure in two classes of locomotives. Conditions and requirements are constantly changing. The railroad surgeon is a developer and a creator, constantly confronted by new conditions and called upon to solve problems on which past experience cast but little light and afforded but little guidance.

At the risk of seeming elementary, I desire to clear away some of the rubbish of what seems to be a popular misconception of railroad machine-shop work in order to get a basis on which to found future arguments.

1.—Scientific management, unless the term is a misnomer, means practices founded upon "accumulated and accepted knowledge which has been systematized and formulated with reference to the discovery of general truths or the operation of general laws" (Webster). Ascertaining fundamental truths by trials and through observations and experiments is exploitation and discovery. It leads to, but is not, science. In a railroad shop there will always be many unsolved problems. It is more frequently a question of what should be

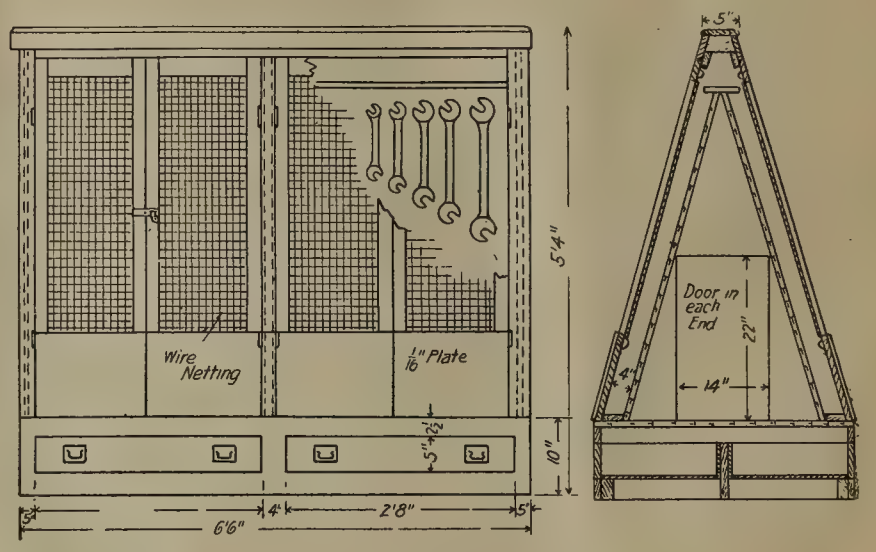


Fig. 25—Tool Cupboard.

done than how to do it. There was no scientific management in brick laying or in gravel shoveling until the results were ascertained, and methods were analyzed and systematized through practice. It was found that the same proportion twenty-pound-capacity shovel would not answer for both oats and gravel.

Railroads are constantly and diligently seeking the best. There are probably more scientific methods in operation in railroad machine shops than in any other department of industrial effort. Proper care of belts is an item, the importance of which I would not belittle. Proper arrangement and organization of shop, modern equipment, correct grinding of tools, and the best speeds and feeds, are important details that railroad mechanics study and appreciate, but their adoption still leaves many problems within the realm of experiment to be solved by the men who are in practical, constant, observing, intimate and responsible contact with the conditions and requirements. The mechanical departments of the railroads have hard-working, diligent associations of experienced men and trained observers who meet in convention for the consideration and discussion of all problems

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*From an article in the Engineering Magazine.

involved in their work. What light could a man not trained by practical experience shed upon the problem of reducing the breaking of locomotive frames, discussed at the last convention of the American Railway Master Mechanics' Association? There is no accepted knowledge until the most successful results have been demonstrated. The ability and opportunity to ascertain are inside, not outside, the railroad shops. The system I advocate seeks to aggregate the best results by collecting and tabulating observation and experience and weighing the value of such by comparison. Nor, in my opinion, would a Co-operative Efficiency Experiment Station, along the lines suggested by Mr. Franklin, be of sufficient value to justify its maintenance. An agricultural experiment station is not a parallel. Railroad efficiency must be developed, not in a laboratory, but in actual, practical, observed, real service. There is no royal or theoretical road to railroad efficiency. In the present railroad mechanics is the greatest staff of trained experts in the world. Every railroad is and must always remain an experiment station. My contention is that there should be a medium of co-operation through which the results and methods of each may be measured and compared, to the end that all may benefit by the best achievements of each. Possibly the advocates of scientific management may contend that I am demonstrating their contention. I contend that while my investigations tend toward and aid in acquiring scientific knowledge, they do not constitute scientific management.

2.—Scientific management presupposes standards. There is no common standard by which the relative efficiency of a railroad machine shop as a unit may be measured and compared. Cost of repairs per locomotive furnishes no basis. The most commonly accepted standard cost of repairs per train mile means but little more. The best measure I have observed is the cost of repairs per 1,000-ton-miles. All such costs are so involved and complicated by carrying shop conditions that they are of but little value as a basis of comparison, even for measuring the relative efficiency of the same shop from time to time.

Nor can efficiency be justly measured by comparing the cost of the same job in different shops. During the recent rate hearing the Interstate Commerce Commission asked various roads to furnish their costs on certain specified jobs. Writers whose articles disclosed an entire lack of comprehension attempted to construct from these reports comparative tables showing the relative efficiency of different shops. I took the matter up with the Interstate Commerce Commission and pointed out some obvious features that made such figures untrustworthy and unreliable. Similar articles have from time to time been published, based on tabulations in the Annual Report of the Interstate Commerce Commission. For reasons I shall herein attempt to show by practical illustrations, such comparisons furnished only misleading light.

3.—Someone has defined a railroad as an industrial enterprise manufacturing and selling transportation. The served public and the investing public are immediately and directly interested in the cost of that product. The aggregate value and cost of transportation is the controlling factor in railroad administration. Locomotive maintenance, while large in the aggregate, is subordinate and relatively unimportant.

In other words, railroads are not managed on the basis of their machine-shop efficiency. In the ordinary manufacturing enterprises the shop is the producing organization and is located with reference to the cost and quality of its product. The railroad machine shop must adapt itself to the practices and constantly changing conditions that serve the main purpose of transportation. How rapid and radical these adaptations have been will be appreciated by comparing a locomotive of today with one of but ten years ago. Some one has said that the marvelous development of the American railway locomotive is due to the fact that the Yankee appreciates the value of the scrap heap.

4.—Wage rates and the varying degree of skill of operatives and legislative regulations and requirements in different sections complicate the problem of a fair and intelligent comparison on the basis of shop costs. In my studies I aim to get one step nearer an intelligent comparison of efficiency by measuring costs, not in dollars and cents, but in hours and minutes.

A railroad machine shop is not and cannot be a manufacturing proposition in the strict acceptance of the term. Its organization on the scientific basis of the best productive efficiency is impossible. Shop systems must be subordinate to keeping the locomotives in service by reducing the time they are in the shop. If a reduction of shop costs would be more than offset by the loss of the engine from service, it must be sacrificed. Such a condition necessitates constantly shifting over of operators from one job or process to another. Every one at all familiar with shop management appreciates that such changes frequently take more time and cost more money than to do the actual work. Costs of locomotive repairs per train-mile could be greatly reduced if road service could be subordinate to the shop.

5.—The nature of the country in which the railroad operates, its climate, the character and quality of its fuel and water supply, grades and curvature, the weight of the locomotives and the rolling stock, and the nature of the traffic, all have important and complicated bearing upon the cost of locomotive maintenance. A road showing the highest cost per train-mile may be conducting its shops with the greatest efficiency.

6.—The size, age, and character of the shop, and the nature of its equipment, though perhaps of highest efficiency when the shop was new, vary so greatly with age, and especially with the rapidly increasing size and weight of locomotives, that the relative efficiency of their operation cannot be reliably measured. A large shop handling more locomotives, or a system that permits the concentration of a considerable portion of its work, can approach nearer to a basis of perfect organized manufacturing. Special tools might disproportionately increase the overhead burden and even increase direct productive cost in a small shop. The advantage of modern tools is conceded, but in discarding older tools discretion must be exercised lest the necessary charge-off increase shop costs to a greater extent than could be offset by the increased efficiency of the modern tools. A reduction in the number of types of locomotives of course would reduce the direct cost of repairs, but in many cases it would involve and in some cases it has involved a sacrifice that it will take a long time for increased shop efficiency to offset.

7.—The overhead burden is in proportion to production. Therefore a small shop, just as scientifically managed and working on precisely the same character of repairs, will show a greater cost per locomotive and per train mile.

8.—The railroads have no common system of bookkeeping by which costs can be accurately compared. Overhead is sometimes ascertained monthly and sometimes fixed arbitrarily. I have seen it computed all the way from 15 to 61 per cent.

9.—Labor unions are opposed to scientific management, to piece work, to bonus, and to efficiency systems. For the purpose of this discussion it is not necessary to pass upon the merits, the justice, or the wisdom of such opposition further than to consider it as a factor that controls shop methods to a greater or less extent. Labor unions are better organized in the railroad shop than in any other class of shops. Strikes and lockouts are distasteful to the railroads, which are quasi-public corporations and are always up against

public sentiment. The general public, regarding its own immediate interests and conveniences, is apt to be impatient with the railroads when misunderstandings or contentions with their employes reach a stage that interferes with traffic. As this article is being prepared, a great strike is in progress involving economic principles of management that the railroad officers contend would hamper them in their effort to secure results that they desire and the public demands.

Practical Illustrations of Railroad Machine-Shop Work Proving the Foregoing Contentions.

I have said that it is more often a problem of what to do than how to do it. I have so far observed over one hundred and twenty variations of the ten or twelve processes in machining a driving box. The problem is to ascertain the best, measured by cost in the shop and service on the road.

Facing Driving Boxes.

On what class of machine, too, can it be done to the best advantage? I have observed it on lathes, planers, horizontal and vertical mills and shapers.

The horizontal mill gives the best results in actual service in point of time. I have, however, recently seen a planer demonstration under experienced direction on a test job that surpassed the best results obtained on a milling machine. The horizontal mill is of limited range, the most expensive machine in point of first cost, and in upkeep of tools. Its productive efficiency over a modern planer is limited to the once-across operation. If the resulting strain following the first machining is such as to require a second cut, the milling machine is at a disadvantage. Horizontal milling machines of the character required to do efficient driving-box work are in the nature of special tools, and are too expensive and of too limited use to be economical in any but a large shop. In a relatively small number of shops, driving boxes are faced on boring mills. If the recess in the face of the box is to be cut out of the solid, it seems to be good practice to face the hub side at the same setting at which the recess is cut.

A comparison of the time of facing driving boxes on the same classes of machines shows a wide range in the time of doing the work, due partly but not wholly to differences in methods and practices; for instance:

1.—Some shops take a roughing chip only and some take a roughing and smoothing chip. It is probable that a roughing chip is sufficient except when the face of the box is to run on a hub plate.

2.—The design of the box is an important factor in machining time, for the larger the surface the longer it takes to machine it. It is contended by some roads that as the broader-faced box does less damage to the hub, the extra cost of machining is more than offset.

3.—The number of boxes available for machining at one time has an important influence upon the cost per box. Some shops have over 500 boxes per year, while some have less than half a dozen.

Is it really necessary to machine both faces of a driving box? Limiting machining to one face is the elimination of one process and is a step in the direction of economy, not only in time but in the availability of the shop and its equipment, in power and in wear and tear of machinery. Furthermore, unnecessary machining is a weakening process. The box is never so strong as when in the scale. Whether it is practical to limit the machining to one face depends upon the practice in the subsequent operations. Some foremen contend that for the purpose of squaring up, the machining of both faces is of more value than its extra cost. Others contend that owing to the distortion from pressing in the crown brass the back of the box is not reliably square as a base for subsequent machining.

The following practices subsequent to facing seem to call for machining both faces:

1.—When the boxes are piled so as to slot crown and cellar fit of two or more boxes at one time.

2.—Where the practice is to support the box on its off hub side when boring and facing. The best practice seems to be to square the box by its shoe and wedge faces.

End-Play or Lateral Liners.

The most common practice is to take up the lateral on a box liner. There seems to be a growing tendency toward taking up the lateral by a hub plate. Advocates of that practice contend:

1.—That as the hub must ultimately have a liner when it becomes worn, the liner should be put on the hub in the first instance instead of on the box.

2.—As the liner is usually the softer metal, it should have the larger of the two bearing surface, which is the complete circle of the hub plate.

3.—The box when the liner is worn down will do more damage to the hub than the hub with its liner worn down would do the box.

The most usual box liner is babbitt. There is, however, a marked tendency toward casting brass liners in position on the box. The only objection I have heard to this practice is that of round-house repairs. Some shops are using fitted brass cast-iron or steel liners fastened to the box by rivets or patch bolts. My attention was recently called to a fitted brass liner on truck boxes, and I am informed that it is the purpose of the inventor to introduce it for driving boxes and to recommend that it be used without machining. It slips on from the top over dovetail grooves that fit lips on the side of the liner, which is further secured by the cellar bolt.

End-Play Box-Liners.

The practice of some shops is to turn one, two, or three dovetailed channels out of solid. Some roads heat and tin the box before casting on the babbitt. Some tin and cast babbitt on face of box without a channel. In most shops the box is not tinned for babbitt. Some hold the babbitt by anchor holes in face of channel. In some shops the anchor holes are dovetailed. Some shops screw brass plugs in the bottom of the channel, casting babbitt around them. In one shop a brass nut is screwed on each plug and when the liner is faced, the faces of the nuts serve as part of the bearing surface. Some roads plane one or more dovetail slots across the face of box.

Practices Which Those Who Have Adopted Them Claim Make for Economy in Facing and End-Play-Liner of Driving Boxes, and the Arguments Advanced in Their Favor.

1.—Unless it is the practice to run the steel box on a brass or babbitt hub plate, face but one side of the box, except where the box is to be turned when the original hub side becomes worn. This practice makes it necessary to square the box by shoe and wedge faces when boring and facing.

2.—Run the face of the steel box on a brass or babbitt hub plate. This simplifies the box practice and gives the larger bearing surface (the complete circle) for the softer metal. Because of a broader bearing surface, the unlined box face will not cut the hub of the wheel should the hub plate become worn down.

3.—If the practice is to put a babbitt liner on the hub side of the box, core the recess with slightly eccentric sides and cast the babbitt on the scale of the cold box. If there is any apprehension about the babbitt holding, sink anchor holes or break down the edge of the channels in two or three places. It does not seem to be necessary to tin the box before casting on a liner. Coring the hub side of the box necessitates good foundry practice. It is more economical to cut the recess out of solid than to attempt to clean out a poor coring.

4.—If the practice is to cast a brass end-play liner on the hub side of the box, the recess must be machined because the brass so clings to the scale that cleaning out the old brass will be difficult.

5.—One recess channel seems to be as effective as two or more.

6.—The labor of casting on brass liners should be scarcely if any more than casting on babbitt liners.

7.—It has been found that casting brass liners integral with the crown brass is objectionable in that the wear on the two parts is not the same. The practice is not growing.

8.—Brass runs well on steel, but roads running brass on babbitt complain of poor results.

9.—The use of babbitt wheel plates is urged by some. One road at least is using them exclusively on freight service and reports good success. There is no physical reason why babbitt should not give as good service in the form of a wheel plate as it will as a box liner. It is practical to cast the babbitt wheel plate in position without upending the wheel and to get the lateral without the necessity of subsequent machining. It is urged that the one-piece babbitt hub plate cast in place is superior in economy and efficiency to the two-piece brass, steel, or iron plate bolted on. I have inquired why some roads that tried the babbitt hub plates had abandoned it. I am assured in one instance that the failure was due to the poor quality of babbitt used.

10.—Brass, steel, or cast-iron hub plates put on in halves are fastened to the wheel by copper rivets or by brass or steel patch bolts. Copper and brass rivets are urged because if they work loose they will not cut the face of the box. They are, however, weaker than steel. The objection to steel bolts working loose seems to have been effectively overcome by cutting a channel in the side of the counter sink and upsetting the head of the bolt into it, thus preventing the bolt from turning. One road puts on hub plates in one piece by removing one driving wheel. It has been urged that this is liable to so distort the wheel as to change the quartering of the crank pins.

11.—There seems to be an increasing tendency to lubricate the end play with grease. On one road a hole is drilled from the grease channel in the crown of the crown brass to the face of the box through which the grease will be forced when the locomotive is running. The objection is raised that grease is not a good lubricant for babbitt, which seems to cut and grind, perhaps because of the presence of dust picked up and held by the grease. One road oils the hub by wicking up from the oil cellar in the top of the box. The most general practice seems to be to require the engineer to oil the hub.

STEEL MOTOR CARS IN COLLISION.

Omaha, Neb., Dec. 13, 1911.

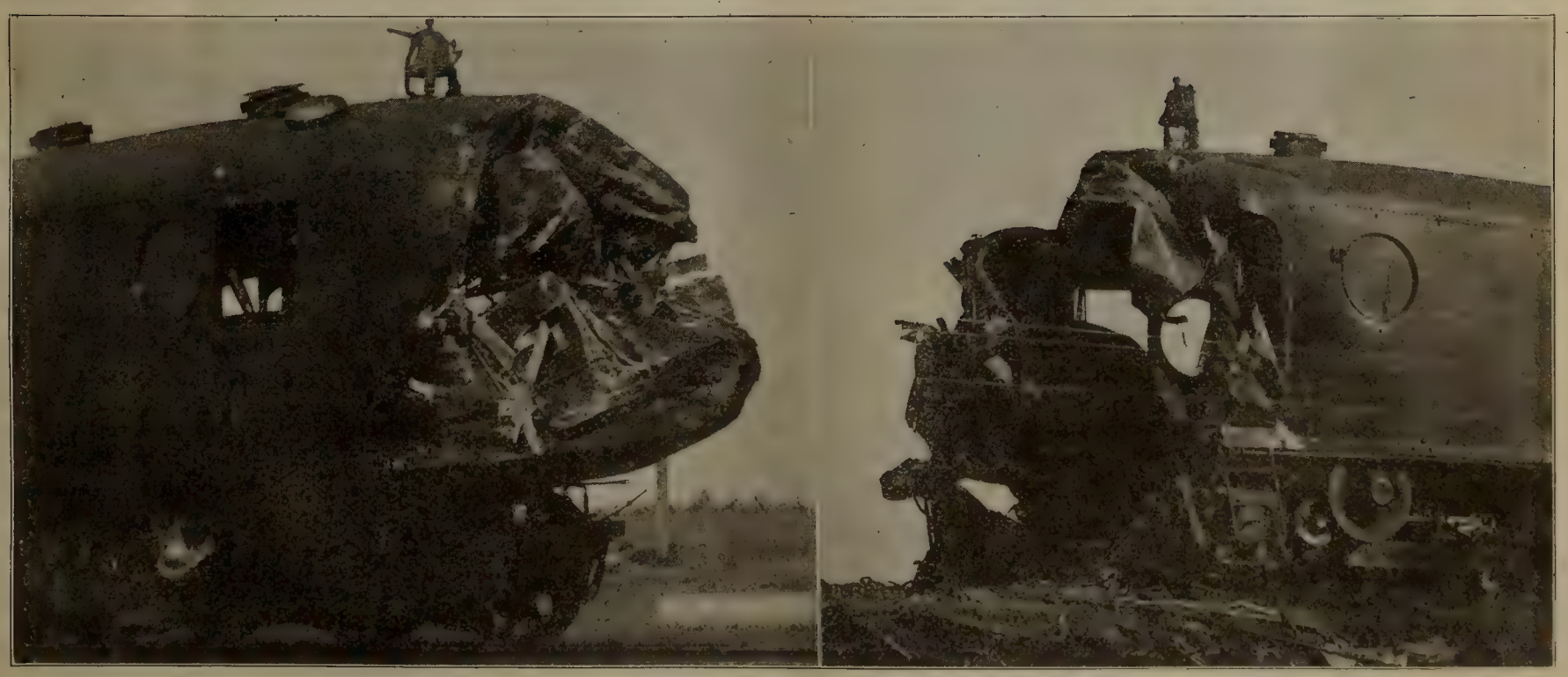
Editor Railway Master Mechanic: Two 70 ft. McKeen steel gasoline motor cars recently met in a head-on collision with the resultant damage to the cars as illustrated in photographs reproduced herewith. The impact speed at the time of the accident, which occurred on a sharp curve, was between 75 and 85 miles per hour. There was no loss of human life in this wreck and while some of the passengers sustained slight bruises none of them nor the crews suffered a broken bone. This is therefore a very remarkable accident in that it accomplishes one of the most important results for which the McKeen, all-steel, gasoline motor car was designed, namely the absolute safety of its occupants.

Notwithstanding the terrific shock the cars did not telescope and suffered no damage except to the pointed front ends and adjacent supporting and bracing members. The gasoline engine in each car was not damaged and not a wheel of either car was derailed. Beyond the point where the steel structure shows distortion or disfiguration the car framing and roof sheets are all in perfect condition.

The features of the McKeen motor car frame which produce a construction of extremely light weight with such tremendous strength are the wedge shaped front end with the round rear end; the single center "I" beam sill connecting the forward with the rear end of the car; the steel channel side sills, which are continuous around the entire car; the depressed side sill in the middle of the car, which enables a combination plate and truss girder to be worked out of the side of the car (thus the resistance offered by sides of the car in case of impact). The distance from the side sill to the plate gives a depth of girder of about 8½ feet, which depth of girder could not be obtained except by the use of the round windows, which enables the diagonal braces to run up to the requisite height.

There are no posts in this car but there are ribs and stays similar to those of a ship, the channel iron section extending from one side of the sill upwards, forming the posts, carline, and posts on the other side of the car, tying all together and in combination with both the side sills.

The rigid rectangular brace in the center and over the body bolster at the end of the car, affords much strength



Steel Motor Cars After Collision.

in this style of construction. The rigid triangular braces connecting the depressed side sills with the center sill of the car, also is a unique and very efficient feature of the car design.

Therefore in a collision the McKeen motor car with this style of framing has the whole metal cross section brought into play resisting the shock, not only the sills but the side plates, the steel siding, the roof, and all other metal forming a part of this steel frame assumes its proportion of the burden, whether it be a shock incident to a collision, or whether it be stresses incident to a heavy load.

W. R. McKeen.

CHICAGO CAR INTERCHANGE.

The question of the establishment of joint car inspection for the city of Chicago has been under consideration for some time by a committee of the General Superintendents' Association. Seven roads are members of this interchange committee, namely: L. S. & M. S.; C., M. & St. P.; C., R. I. & P.; C. & W. I.; C., B. & Q.; A., T. & S. F. and the Pennsylvania. At a meeting held Dec. 22 Mr. Le Mar of the Pennsylvania was made chairman and the establishment of joint interchange was finally decided upon, the association to be called the Chicago Car Interchange Bureau. Mr. F. C. Schultz was appointed chief interchange inspector and the Chicago territory divided into eight districts each to be in charge of an assistant interchange inspector. It will be a matter of a month or two before the system is put in active operation and in the meantime Mr. Schultz and his associates will carry on a campaign of education to familiarize the inspectors and foremen with the M. C. B. rules. C. H. Treichel has been appointed chief clerk of the bureau, and the following assistant interchange inspectors have been appointed at this writing: Stewart Johnson, I. H. Clark, O. F. Koepp, A. E. Schultz and R. E. Forbes.

Mr. Schultz, who is to be at the head of interchange inspection in Chicago, was born March 13, 1870, received his education in the public schools of Chebanse and Kankakee, Ill., and entered the service of the Burlington in 1888, as a car repairer at Chicago. Two years later he was made an air brake inspector. From 1892 to 1896 he was a car inspector at

F. C. Schultz, Chief Interchange Inspector, Chicago.

Chicago, and from 1896 to 1904 was car inspector and assistant agent at La Grange, Ill. In 1904 he was made chief car inspector for the Burlington at Chicago, which position he has held up to the present. He is first vice-president of the Car Foremen's Association of Chicago and a member of the executive committee of the Chief Interchange and Car Foremen's Association of America. His new office is at room 603 of the Baltimore & Ohio station, formerly called the Grand Central station.

REPORT OF MECHANICAL DIVISION, ISTHMIAN CANAL COMMISSION.

The report of the mechanical division of the Isthmian Canal Commission for the fiscal year ending June 30, 1911, contains much of interest to those interested in rolling stock and shop equipment. The following is an extract:

The second division of the chief engineer's office has charge of all mechanical questions that may arise and supervises expenditures, the preparation of estimates, and allotments for work. If the dry dock and coaling stations are to be constructed, the design of this work is to be placed under this division. It is in charge of Mr. H. H. Rousseau, United States Navy, as assistant to the chief engineer.

The construction work requires that all mechanical appliances of every character be kept in thorough repair, so that they can be operated without breakdown at their highest efficiency throughout working hours. This necessitates a considerable organization and proper facilities for the inspection, maintenance and repair of all mechanical appliances. To this end shops are provided at convenient points along the line of the canal, certain ones of which are under the supervision and control of the division heads, and others constitute the central manufacturing and repair plant at Gorgona, with outlying subordinate shops and engine houses.

As noted in the last annual report, an inspector of shops was added to the organization, and from the experience gained his duties were more clearly defined, embracing jurisdiction of all the shops of both the commission and the Panama Railroad. The result has been more economical performance of work as well as more efficient and satisfactory service. At the close of the year the number of employes in all the shops on the Isthmus totaled 4,405, of which 1,532 were gold employes and 2,873 were silver men. The number of hourly gold men taken on during the year was 94 per cent of the force employed, indicating that the average length of service on the Isthmus for the mechanical trades continued to be about one year.

A new shop was erected and put in operation at Toro Point for repairing locomotives, cars and other equipment used in the construction of the breakwater. It was equipped with machines taken from other shops. The shed at Pedro Miguel shop used for repairing cars was doubled in size to save the time previously lost by workmen during rains. At the Gorgona shops an addition to the erecting shop was made for the pipe, tin and copper shop, so as to move the equipment therefor from the boiler shop, the latter needing additional space. A small building was erected for the oxy-acetylene plant, and a small building was erected and provided with a 25-ton crane, affording facilities for making large iron castings. An order has been placed for a steel casting plant consisting principally of a 2-ton converter, blower and sand grinder, and when installed the stock of steel castings kept on hand can be reduced and the practice stopped of making repair parts urgently required of cast iron and brass. The permanent equipment was augmented by the addition of one 6-in. turret lathe for making bushings, two heavy milling machines for cutting gears and general work, one automatic tool grinder, an oxy-acetylene plant, one washer cutter for making washers out of scrap metal, a 25-ton overhead crane for use in the foundry, and a Taylor-Barth belt outfit.

With the approval of the division engineer, work in the Cocoli shop was transferred to the mechanical division on Sept. 1 and the shop closed on Sept. 15. The Lirio planing mill was closed and the manufacture of woodwork was consolidated at Gorgona. The keeping of a permanent gang of craftsmen and helpers for making repairs to the cableways and concrete mixers at Gatun locks and day repairs to steam shovels was done away with. The consolidation of heavy repairs at Gorgona and the transfer of repairs to vessels and other apparatus in the vicinity of Colon and Cristobal to

the dry dock shops enabled the closing of the blacksmith, machine, boiler and erecting shops of the Panama Railroad in Cristobal. So that repair and manufacturing work could be done with greater dispatch, night shifts were put in the machine, erecting and boiler shops in Gorgona in August and September. While work of the class involved is usually more expensive when performed at night than during the day, the night shifts have proven efficient and save expense by the elimination of overtime. Another advantage was in reducing the length of time required for completing urgent orders. By putting on a night shift in the wood-car repair shop on Feb. 1, Lidgerwood flats which were cut out of service for light and medium repairs on one day were returned to service the next morning.

According to the present program of work, the Gorgona shops will be retained in operation until the waters of Gatun lake reach elevation 70. By that time, the manufacturing and repair work, especially in connection with locomotives, cars and excavating machinery, will have largely diminished and steps can be taken for the erection of the necessary buildings to which the transfer of machines now at Gorgona can be made at that time. The shops at Balboa and at Cristobal now in operation, together with the Panama Railroad machine shops, which, while closed, are not dismantled, will afford the necessary repair facilities while the transfer of the machinery from Gorgona is in progress.

At the beginning of the fiscal year an additional traveling engineer was appointed to have supervision over fuel and oil consumption and to supplement the work of the other two traveling engineers, whose jurisdiction extended to locomotives only, and later to supervising and instructing engineers in respect to handling oil, and the firemen in regard to methods of firing and fuel consumption. The duties of the new traveling engineer covered steam shovels, unloaders, spreaders and all stationary plants, and was subsequently extended to the marine equipment. Very satisfactory results have been accomplished in saving both in fuel and in lubricants.

Electric current for lighting and power was generated at five stations, located at Balboa, Miraflores, Empire, Gorgona and Gatun. The output of the Gatun and Miraflores plants was largely used in construction work in the Atlantic and Pacific divisions, respectively. The cost per kilowatt hour averaged $0.026. Oil fuel was used in all stations. Current was generated at the Gatun and Miraflores plants by steam turbines, at the Empire and Gorgona plants by noncondensing engines, and at the Balboa plant by condensing engines.

The principal air-compressor plants are located at Las Cascadas, Empire, Rio Grande and Balboa, and furnish compressed air to the central and Pacific divisions, and along the high line around Gold Hill on the relocation of the Panama railroad. The total output from these plants aggregated 8,261,199,541 cu. ft., at a cost of 0.0324 c. per thousand cubic feet. Compressed air for the Gorgona shops is furnished by a smaller plant located there.

The total appropriations made by Congress available to June 30, 1911, amounted to $248,001,468.58, or 66 per cent of the total estimate of $375,201,000 for completing the canal. By the act approved March 4, 1911, additional appropriations were made for the fiscal year 1912, amounting to $45,560,000, exclusive of fortifications, leaving $81,639,531.42 of the total estimated cost of the canal to be appropriated. By June 30, 1911, $225,470,053.26 had been charged into the work. Of this amount, $33,048,607.97 were expended during the fiscal year 1911. The difference between the appropriations available to June 30, 1911, and the classified expenditures to June 30, 1911, amounting to $22,531,415.32, represents unexpended balances in appropriations; unexpended material and supplies in storehouses; and such items as will not be prorated to construction work until the work is completed; buildings of all descriptions, roads, sewers, and water supplies. Of the total classified expenditures to June 30, 1911, $27,580,724.37 were for plant and equipment for construction, of which amount $626,330.86 were expended during the fiscal year 1911.

The disposition of surplus plant and equipment upon the completion of construction work so as to bring the greatest reimbursement to canal appropriations is a matter of growing importance. The policy of the commission during the construction period has been to keep all machinery, plant and equipment in the best possible condition, both on the ground of economy and for efficiency, and after an average use of not much more than five years, at even 10 per cent depreciation a year, it should have a value fully half of its original cost. The prices which will be obtained from actual sale can not be foretold. The gauge of all rolling stock and equipment used on the standard 5-ft. Isthmian tracks will have to be changed to the standard 4-ft. 8½-in. gauge in the United States. This possibility was taken into consideration on practically all equipment ordered after 1906, and the change can be made with little difficulty and expense. To change the gauge of locomotives will cost about $250 apiece, or 2½ per cent of their original cost.

Up to the close of the fiscal year 1911, little or no plant and equipment had been permanently tied up, and it will be another year before any considerable number of the different units will be available for sale, which will permit from two to three years being taken to gradually dispose of the old plant before the canal is opened for traffic. A certain proportion of the plant, including rolling stock, equipment and excavating machinery, will naturally be reserved on the Isthmus indefinitely to take care of maintenance work and any future requirements. This amount could be reduced gradually after the canal has been operated a year or two. The best of the shop tools and machinery will be reserved for the permanent shops. There will be left about 150 large American mogul engines, weighing, with tender, from 105 to 117 tons each, in excellent condition, available for sale, and over 1,500 steel dump cars, weighing from 16 to 22 tons each. The cars of wooden construction will probably not bear transportation back to the United States intact on account of the deterioration of the wood. The metal parts will be useful in rebuilding cars in the United States. A good deal of the marine equipment will be useful in the maintenance and operation of the canal after completion, including tugs, barges and some dredges. It is not believed that the condition of the seven old French and Belgian ladder dredges, which are being used on the canal, will, at the end of the work, warrant their transportation to the United States for further work.

All shops of both the commission and Panama Railroad Co. are under the general supervision of the inspector of shops, along the lines of securing the most efficient management, inspecting and recommending the most economical distribution of work, employes and tools among the different shops, and the adoption of standard methods therein. This, while it leaves the control of the operation of some of the mechanical work directly under the different division heads, at the same time insures the requisite co-ordination and co-operation between all shops and all mechanical work on the Isthmus.

During the year heavy repair work and all manufacturing work so far as practicable has been concentrated at Gorgona shops. This, in connection with the transfer of some work to the Cristobal dry-dock shops, has enabled the metal-working shops of the Panama Railroad Co. at Cristobal to be entirely closed and a considerable saving made.

The past fiscal year has not been marked by any serious labor disturbances in the shops. For some time the hourly gold employes, over four-fifths of whom are employed at the various shops, have been endeavoring to secure the same leave with pay privileges as the gold monthly employes. The hourly employes are paid for all overtime; the monthly employes receive no extra compensation. In September, 1909,

the Secretary of War granted hourly gold employes two weeks' leave with pay each year, effective Jan. 1, 1910. In November, 1910, President Taft, while on the Isthmus, gave several delegations of hourly gold employes employed in the shops hearings on their application for either an increase in pay or additional leave of absence each year with pay, and on his return to the United States authorized, effective Jan. 1, 1911, the granting to hourly gold employes of four weeks' leave of absence with pay per annum, with privilege to accumulate their leave with pay to not over eight weeks, which, with their overtime pay, puts them on practically the same basis as regards leave privileges as the monthly gold employes. Before this decision was announced, the boiler makers on the Isthmus resigned almost in a body and went back to the United States, 177 taking this action during November and December, 1910. The action of these men was not sustained by the boiler makers' federation in the United States, and their places were filled with very little inconvenience or delay.

The wage scale has remained at 65 cents an hour for first-class mechanics, and during the last half of the fiscal year labor conditions were satisfactory. The force of shop mechanics is one of the most unstable of the different classes of gold employes. At the latter part of the year there were about 1,200 hourly gold mechanics employed by the commission.

Constant effort has been made during the year by all concerned to reduce the cost of repairs to equipment, as well as the cost of the operation and maintenance thereof, through the introduction of improved methods of supervision and by enlisting the interest of those concerned in securing as great a degree of economy as practicable. The total cost of repairs to equipment in continuous service and the cost of repairs per service day during the year ended June 30, 1911, and similar information for the last six months of the previous fiscal year, is given in the following table:

Items of equipment.	Six months ended June 30, 1910.			Fiscal year 1911		
	Service days.	Total expense	Average cost per service day.	Service days.	Total expense.	Average cost per service day
Locomotives	31,955	$221,760.01	$6.94	63,926	$504,008.10	$7.88
Steam shovels	9,527	263,550.54	27.66	21,775	483,536.88	22.21
Unloaders	1,655	34,015.34	20.55	3,417	50,564.45	14.80
Spreaders	1,127	19,496.48	17.30	2,290	33,815.41	14.77
Track shifters	798	5,326.12	6.67	1,170	2,632.84	2.25
Locomotive cranes	3,075	11,684.20	3.80	5,851	43,502.39	7.44
Pile drivers	442	4,165.78	9.42	1,173	6,676.15	5.69
Unloading plows	1,655	6,267.61	3.79	3,417	11,291.45	3.30

The total cost of car repairs, all classes, for the same period was $894,496.55, or an average of $0.8656 per car per working day, as compared with a total cost of all car repairs for the six months ended June 30, 1910, of $479,165.75, or an average of $1.03 per car per working day.

The large decrease in the cost of repairs accomplished during the year speaks for itself. The increase in the cost of locomotive repairs was due to a combination of an unusually large amount of general repairs and repairs due to casualties.

Electric current for lighting and power is generated at five stations on the Isthmus located at Balboa, Miraflores, Empire, Gorgona and Gatun. The output of the Gatun and Miraflores plants is largely used in construction work in the Atlantic and Pacific divisions, respectfully.

Oil is used as fuel in all of these stations. Current is generated at the plants at Miraflores and Gatun by steam turbines; at the Empire and Gorgona plants by non-condensing engines; and at the Balboa plant by condensing engines.

The principal air-compressor plants are located at Las Cascadas, Empire, Rio Grande and Balboa, and furnish compressed air to the Central and Pacific divisions, and the work along the "high line" around Gold Hill on the relocation of the Panama Railroad.

In addition to lessened cost of repairs, economy in operation and maintenance has been secured through the co-operation of all concerned by reducing steam consumption through the more economical operation of the different units and by an appreciable saving in fuel, lubricants and other similar supplies. At the beginning of the fiscal year an additional traveling engineer was appointed to have supervision over fuel and oil consumption to supplement the work of the other two traveling engineers whose jurisdiction extended to locomotives only. His work covered steam shovels, unloaders, spreaders and all stationary plants, and has since been extended to marine equipment with very satisfying results.

The Isthmian Canal Commission and the Panama Railroad Co. are using together at present about 35,000 tons of coal per month, which at an estimated cost of $6 per ton delivered into the firebox, amounts to $210,000 per month. In addition about 75,000 barrels of fuel oil, at $1.10 per barrel, are being used, amounting to $82,500 per month. The cost of lubricating and illuminating oils, greases and waste is over $5,000 per month, making a total approximate cost for fuel, lubricating and illuminating oils, etc., of about $3,600,000 per annum. A saving of 10 per cent of this amount would be $360,000 per annum, or about $1,000 per calendar day.

It has been found by actual trials that there are very few installations on the Isthmus where one of the traveling engineers can not, when firing himself, make a saving in fuel consumption of considerably more than 10 per cent, as compared with the work of the regular fireman, and the present efforts of the traveling engineers are being directed to securing this saving by personal instruction in firing.

A system has been established of training firemen, especially for locomotives, so that they are required to qualify before being taken on as regular firemen. The breaking in of Spaniards as firemen has met with success.

The same work has been carried on to obtain economy in the use of fuel oil. To demonstrate the savings obtainable by correct firing, tests at the different plants have been made, showing the fuel consumption by the regular force for a period of 12 hours with that under the firing of the traveling engineer for a like period. The savings in all stationary plants have been considerable. For instance, at the Las Cascadas air-compressor plant the saving by this comparison was shown to be 3.5 per cent; at the Mount Hope pumping plant 22 per cent; at the Gorgona pumping plant 15 per cent; and at the Cucaracha pumping plant 11 per cent.

In connection with methods employed to secure economy, the fireroom forces at the different plants, including firemen, oilers and helpers, have been standardized and reduced in number. All surplus tools and supplies being carried in the different small stationary plants have been required to be returned to store.

Considerable progress has been made during the year toward putting the consumption of lubricants on a satisfactory basis. Lubricating and illuminating oils and lubricating greases, which cost the commission and the Panama Railroad Co. a total of about $137,500 in the fiscal year 1910, cost about $80,600 only during the fiscal year 1911, a reduction of about $57,000, or over 40 per cent. The reduction in the quantity of lubricating oil purchased was 16 per cent and of lubricating greases purchased 60 per cent. The reduction in the average cost of lubricating oil per gallon was 30 per cent and in the average cost of greases per pound 25 per cent.

This result was attained in spite of an increase in fuel consumption of about 13 per cent, which would naturally be accompanied by an increase in the use of lubricants. This saving was due principally to the following:

1. Reduction in the price paid for lubricating oils through the advantages of competition.

2. The obtaining of practically all oils in metal drums which are returned to the contractor when empty, thus eliminating the cost of barrels or tins in which oil had previously been shipped.

3. The substitution of cheaper lubricants for higher-priced lubricants; for instance, formerly engine oil was used for lubricating steam-shovel chains, then car oil was adopted, and at present satisfactory results are being obtained by using crude petroleum for this purpose at less than one-fourth the cost.

4. The placing of all equipment on a fixed daily or monthly lubricating oil allowance, and the close supervision of the consumption of the same by the traveling engineers.

The saving during the past year due to the first two items amounted to over $30,000, and to the last two to over $20,000.

The fact that the Isthmian Canal Commission and Panama Railroad Co. are lubricating their locomotives and cars cheaper than railroads in the United States is worthy of notice.

During the past two years the commission and the Panama Railroad Co. have purchased all of their lubricants under an annual contract from one contractor, who was the lowest responsible bidder. The specifications under which the contracts were made involved a wide departure from the usual practice in other branches of the government service and in commercial practice in especially the following respects:

1. No attempt has been made to describe or limit the qualities of the different lubricants, the sole requirement being that the oils must be satisfactory for the purpose for which intended.

2. All lubricants must be recognized brands of experienced manufacturers.

3. The contractor must keep a representative on the Isthmus during the continuance of the contract to both supervise the use of the lubricants and to take prompt action in replacing any unsatisfactory oils delivered.

During the past two fiscal years and for the fiscal year 1912 annual contracts for lubricants have been awarded twice to the same firm and once to another company, and during the continuance of these contracts the lubrication of railroad and other rolling stock and equipment has been very satisfactory as regards both the quality of the lubricants furnished and the low cost of the lubrication. It has been impossible to detect any difference in the service rendered by these lubricants as compared with the service rendered by the higher priced lubricants used prior to the time the commission inaugurated the policy of purchasing all lubricants under annual contract by competition.

At present the Panama Railroad Co.'s locomotives average about 53 miles per pint of valve oil costing 2.4375 cents delivered on the Isthmus, and about 23 miles per pint of engine oil costing 1.375 cents, making a total cost for lubricating a locomotive per 1,000 miles of about $1.06. The locomotives of the commission are doing as well if not better. If railroads in the United States were able to equal these figures of cost of lubrication, making due allowance for service and for size of equipment, it would be to their very material advantage—a benefit they could very justly attribute as being derived from the construction of the Panama Canal.

THE INVENTOR.

By N. H. S.

Is this not a strange man? He looks hungry and needs a shave. Mortification has set in on his necktie, and the front of his coat is covered with congealed gravy. He has a bundle under his arm which looks like a bag full of augers. Those are ideas he has, and he is going to see his attorney who sits in his office furnished in real leather and mahogany, and a brass cuspidor. The inventor has a wife at home who takes in washing, and a red-headed daughter who operates a filling machine in a bologna works. They have worked six months for the money the old man has in the greasy tobacco bag. The attorney will talk to the unwashed guy, and fill him full of prunes about his edible bicycle tire. He will then do a vanishing stunt to the old man's wad, and paint him a word picture of the family riding in a gold-plated seven-cylinder Panhard Limousine, with a fur-coated wooden-faced James at the tiller. The old man stops at the nearest jewelry store and sees a diamond in the window as large as a guinea egg, which he promises to have set in the handle of his snow shovel when he gets his first royalties. He will then go home and tell the family all about it, while they are eating their corned beef and cabbage, and they all go to bed doped. It will be a long while for the old man to get wise but in the meantime his imagination is working double shift.

We would rather work for a living than be an inventor. —*The Silent Partner.*

The Atlanta, Birmingham & Atlantic is reported in the market for ten Mikado locomotives.

The Chicago, Rock Island & Pacific is figuring on 45 Mikado locomotives.

The Grand Junction & Grand River Valley expects to purchase one electric locomotive soon.

The Paulista Railway, Brazil, has ordered 4 ten-wheel locomotives from the American Locomotive Co., cylinders 17 in. x 20 in., diameter driving wheels 48 in., and total weight in working order 96,000 lbs.

The Sydney & Louisburg has ordered 1 consolidation locomotive from the Montreal Locomotive Works.

RESULTS OF ELECTRIFYING THE HOOSAC TUNNEL.

Continuous operation by electric power in the Hoosac tunnel of the Boston & Maine Railroad was started by the Boston & Maine R. R., May 27th, 1911. The electrification was fully described in the *Railway Master Mechanic* for November, 1911, page 501. Since starting, the electric service has never been interrupted. The Hoosac tunnel is the longest tunnel in the United States. It pierces the range of hills between the Hoosac and the Deerfield Rivers in the Berkshire Hills, and is 25,081 ft. long. To drain off the large amount of water, the tunnel was run on a grade of 26.4 ft. to the mile from each portal to a short level stretch in the center. At the center there is a shaft 1,028 ft. deep extending to the surface for ventilation.

The electric zone extends from the little tunnel west or north Adams station to a point about a quarter of a mile east of Hoosac Tunnel station, a total distance of 7.92 miles. The electrification includes the yards at North Adams, about two miles of main line between North Adams and the west portal, four and three-quarter miles of tunnel, the yards on the east side and about three-quarters of a mile of main line. There is in all 21.31 miles of a single track electrified.

In considering the good performance of the Hoosac tunnel equipment it is well to consider the conditions leading to the electrification and at the same time how these conditions have been changed by the use of electric traction. The following tabular statement indicates the situation.

Previous to Electrification.

(1) Tunnel limit of capacity of division because:

As it was impossible to see, the tunnel was an absolute block five miles long and not more than one train was ever allowed on one track at the same time. As an additional precaution, no other train was allowed in the tunnel with a passenger train.

Owing to the bad rail due to moisture from condensing steam, the steam locomotive was not able to develop its full rating.

(2) There was great expense in maintenance of road bed, tunnel arch and cars because:

Smoke and gases were so thick that a gang of men in the tunnel all day could often do only a few hours' work.

Rock and brick work continually torn down by exhaust from steam locomotives.

Telephone lines corroded by acid gases and instruments plugged up with soot.

Passenger cars become dirty from smoke.

(3) The tunnel has been dangerous to employes because:

Engine men and track men have been overcome by the smoke, and track men have been killed in the dark, not knowing which way the train was coming, and being unable to find a man hole.

(4) The tunnel was unpleasant to passengers because:

The tunnel was a black, dirty hole, and it was necessary to shut all windows and ventilators on passenger trains. At best it was close and hot.

After Electrification.

(1) Tunnel no longer limit of capacity of division because:

With the smoke and gases eliminated, it is now possible to see, and automatic block signals have been installed which allow three trains on each track at the same time. This gives three times the capacity for freight service, and six times the capacity for passenger service.

With the better rail due to the elimination of condensing steam, the electric locomotive can pull as much in the tunnel as outside.

(2) Maintenance expense is moderate for road bed, tunnel arch and cars because:

There is no smoke or gases. Men are able to do good work all day long.

Rock and brick work no longer shattered by exhaust.

Air is clear from gases and comparatively dry. Telephone lines are not effected.

Passenger cars do not become dirty from smoke.

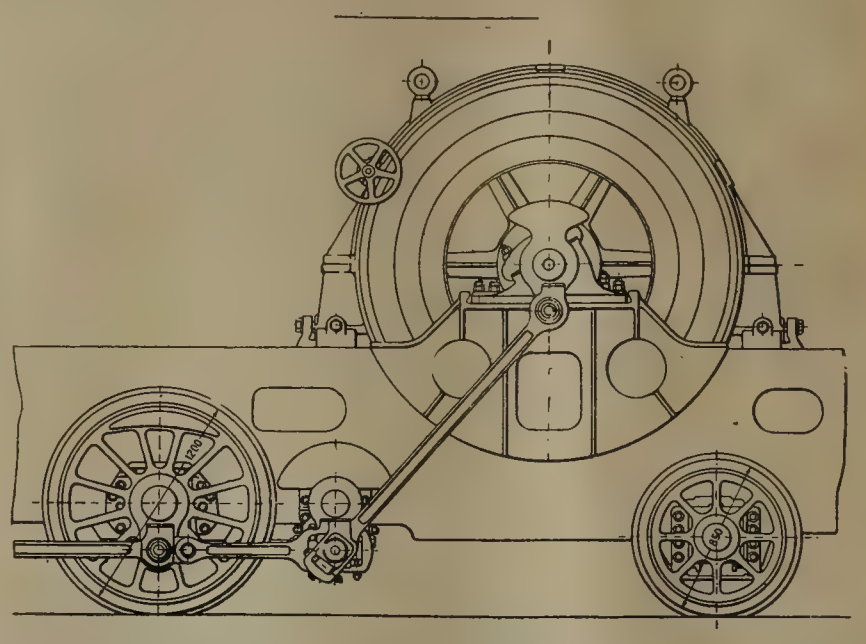
(3) The tunnel is now comparatively safe for employes because:

With the clear air engine men are not inconvenienced and track men can easily see and avoid an approaching engine.

(4) The tunnel is no longer unpleasant to passengers because:

The tunnel is now practically free from smoke and gases and passenger trains go through with windows open. The passengers find the cool air refreshing on a hot day.

Trains are no longer packed three, four or five deep at each portal of the tunnel, waiting for a chance to get through. The capacity of the tunnel is now largely determined by the size of the power house, the number of electric locomotives and the number of blocks, all of which may be increased as necessary.



Details of Motor Mounting and Drive, German Electric Locomotive.

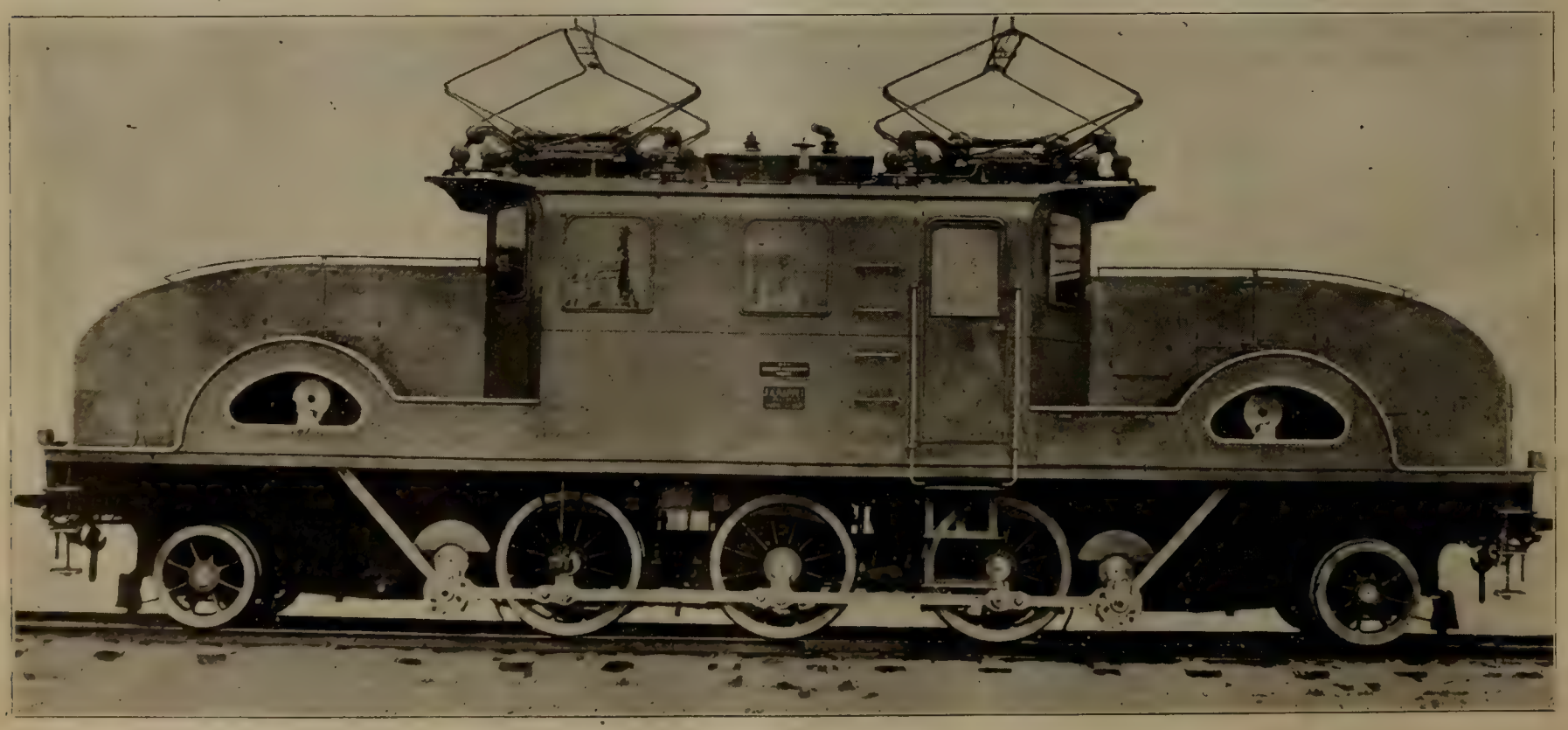
A 10,000 VOLT ELECTRIC LOCOMOTIVE.

The general design and details of construction of a German high power electric locomotive on the Weisenthanbahn in Baden are shown in the accompanying illustrations, the locomotives operate on an alternating current of 15 cycles and 10,000 volts.

The mechanical part of this locomotive was built at Munchen at the works of J. A. Maffei by the Siemene Schuckertwerke of Berlin. The electric locomotives of Weisenthalbahn haul trains from Basel to Zell and from Schopfheim to Sakkingen on the Rhine.

On this electric line there are in service twelve high speed passenger cars having a capacity for 51 persons together with 21 heavy baggage cars. This electric locomotive has two motors of 500 horsepower each the total output being 1,000 horsepower. It weighs 52 tons and operates at a normal speed of 45 kilowatts per hour and a maximum speed of 75 kilowatts per hour.

The electric power for driving the trains on this line is supplied from the Rhine generating station at August, the current having a frequency of 15 cycles and a pressure of



German Electric Locomotive for High Tension Service.

6,800 volts at the generators. The current is raised to 10,000 volts at a substation at Basel. There are two machines of 2,100 kilowatts capacity service in connection with a regulating storage battery plant. The electric locomotives are said to haul passenger trains of 230 tons and freight trains of 500 tons over grades as heavy as 10 per cent between Basel and Zell.

Hall's M. C. B. Repair and Defect Card Box (Front).

M. C. B. REPAIR AND DEFECT CARD BOX.

The accompanying illustrations show a repair and defect card box for equipping all cars which leave the home road. This box is the invention of W. H. Hall, chief car inspector of the Central R. R. of New Jersey. The box is made of galvanized iron and has a spring lid. It can be riveted to steel sills or bolted to wooden sills.

The use of the box is said to insure a clean bill of repairs or defects when cars are returned from foreign roads or when interchange cars are returned to foreign roads.

Hall's M. C. B. Repair and Defect Card Box (Back).

EXCELLENT ADVICE.

In February a few years ago, according to the Railway Journal of Canada, the railway lines throughout Ontario were almost completely tied up by the worst blizzard experience din several years.

The Canadian Pacific has a first-class service between Montreal and Ottawa, and though the daily papers had forecast bad snowstorms, the President of the Bank of Montreal, Sir Edward Clouston, had an engagement of such importance in Ottawa that he decided to take the trip.

The train crew had a desperate fight to make headway almost from the moment they left Montreal yards. Finally when about 3 miles from one of the smallest stations on the line, the engine went dead, in spite of the crew's best efforts.

Sir Edward Clouston is a warm personal friend of Sir Thomas Shaughnessy, President of the C. P. R. When the train stopped he, like practically all the other passengers, at once made enquiries and was informed that the delay would probably be a serious one, a matter of hours.

Learning that the brakesman was about to walk to the station, Sir Edward insisted that a personal message to President Shaughnessy should be sent for him, and also insisted that an answer be brought him.

His message was as follows:

"Sir Thomas Shaughnessy,

"President Canadian Pacific Railway:

"Am tied up in a snowstorm in one of your trains three miles from nowhere. What would you advise?

"Sir Clouston."

As is usual in times of serious snow storms, the wires were giving a good deal of trouble, so the brakeman took nearly three hours to bring back the answer. It was clear and to the point, reading as below:

"Sir Edward Clouston,

"C. P. R. Train Three Miles from Nowhere:

"Advise patience and prayer.

"Shaughnessy."

Personals

W. A. Nettleton, general superintendent of motive power of the Rock Island, has resigned and T. Rumney of the Erie has been appointed to succeed him as head of the mechanical department. Mr. Nettleton has been in railroad work for twenty-six years, starting as rodman for the Kansas City, Ft. Worth & Memphis, a road of which Mr. Nettleton's father was one of the builders. Mr. Nettleton will, it is understood, devote his time to private affairs. Wm. Schlafge succeeds Mr. Rumney.

T. Rumney.

J. F. Sheahan has been appointed master mechanic of the Georgia and Florida, with headquarters at Douglas, Ga.

J. W. Small, superintendent of machinery of the Missouri Pacific, has received the appointment of superintendent of motive power of the Galveston, Harrisburg & San Antonio and associated lines, with office at Houston, Tex., succeeding J. J. Ryan, deceased.

T. Dunlop, mechanical superintendent; Maynard Robinson, master mechanic; T. O. Ward, purchasing agent, and E. S. Newton, general storekeeper of the Gulf, Colorado & Santa Fe, have had their jurisdiction extended over the Pecos & Northern Texas, from Coleman to mile post 461.

H. C. Needham has been appointed master mechanic of the Southwest system of the Pennsylvania Lines West, succeeding to the duties of J. W. Hopkins, general foreman at Richmond, Ind. The office of general foreman has been abolished. F. V. McDonnell, master mechanic at Mahoningtown, Pa., succeeds J. J. Walsh, transferred, as master mechanic of the Southwest system at Logansport, Ind.

John H. Mason has been appointed road foreman of engines with jurisdiction over the Lehigh Valley and Susquehanna division of the Central R. R. of New Jersey, succeeding A. B. Enbody, promoted. The office is at Mauch Chunk, Pa.

W. W. Scott, formerly superintendent of shops of the Cincinnati, Hamilton and Dayton at Indianapolis, Ind., has been appointed shop superintendent of the Pere Marquette, succeeding C. K. Woods, resigned. Mr. Scott will have offices at Saginaw, Mich.

J. F. Sheahan.

J. T. Andrus, purchasing agent of the Washington R. R. and Navigation Co. at Spokane, Wash., has resigned, and the position has been discontinued. Purchases for that division are made by R. Koehler, general purchasing agent, at Portland, Ore.

J. F. Bowden, master mechanic of the Baltimore and Ohio at Garrett, Ind., has had his jurisdiction extended, and is now in charge of the Chicago division and the Northwest systems, including the Baltimore and Ohio Chicago Terminal. G. A. Small, formerly superintendent of motive power of lines west of the Ohio river, is to have charge of the Wheeling system only. D. H. Watson, general foreman locomotive department, has been placed in charge of the shops at Garrett, Ind.

W. W. Scott.

E. H. Harlow, master mechanic of the Atchison, Topeka and Santa Fe Coast Lines, at Richmond, Cal., has been appointed terminal master mechanic at Richmond. John Pullar, division foreman at Los Angeles, has been appointed master mechanic with office at Fresno, Cal.

J. A. McCrea has been appointed general manager of the Long Island, with offices at Pennsylvania Station, New York. H. W. Thornton has been appointed general superintendent to succeed J. A. McCrea. The office of assistant general superintendent has been abolished.

R. H. Hunter has been appointed acting assistant superintendent of the Idaho division of the Oregon Short Line, with headquarters at Pocatello, Idaho. H. W. Joslyn has been appointed assistant superintendent with office at Glenns Ferry, Idaho.

E. Hjorth succeeds W. H. Baker as general foreman of the Chicago and North Western at Belle Plaine, Ia.

V. R. Greiner has been appointed master mechanic of the Cincinnati, Hamilton and Dayton at Lima, O.

J. J. McNeill has been appointed supervisor of locomotive operation of the Erie at Cleveland, O. He succeeds D. J. Madden.

W. D. Johnston has been appointed master mechanic of the International and Great Northern to succeed J. H. Sheahan. His office is at Palestine, Texas.

R. A. Wiggins succeeds E. C. Hause as master mechanic of the Louisville and Wadley at Wadley, Ga.

P. Alquist succeeds J. F. Considine as foreman of car repairs of the Pere Marquette at Grand Rapids, Mich.

F. A. Eichorn succeeds D. V. Musgrove as master mechanic of the Tennessee, Alabama and Georgia, with office at Alton Park, Tenn.

W. P. Myers succeeds W. Percy as general foreman of the car department of the Atchison, Topeka and Santa Fe Coast Lines at Los Angeles, Cal.

J. P. Worthley succeeds W. C. Lambert as division foreman of the Oregon Short Line. Office at Montpelier, Ida.

P. Jimenez has been appointed master mechanic of the San Marcos and Huajuapam de Leon at Rosendo Marquez, Pue, Mexico. He succeeds A. Meneses.

W. E. Sharp.

W. E. Sharp, general superintendent of shops for the Armour Car Lines, resigns that position to become vice-president and

general manager of the Grip Nut Company, Old Colony Bldg., Chicago. Mr. Sharp began railroad work in April, 1890, when he entered the employ of the Erie Railroad at Huntington, Indiana, as laborer in the car shops. He advanced rapidly through the car and locomotive departments until 1898, when he was division general foreman of the locomotive and car department, which position he resigned to become assistant shop superintendent for the Armour Car Lines. In 1900 he was advanced to shop superintendent and later to his present position as general superintendent of shops, and in the future he will remain as consulting engineer to the company he has served for thirteen years. Mr. Sharp had a very active part in the forming of the Car Foremen's Association, and has always taken an active interest in the interchange work at Chicago and other important railroad centers. He is a member of the Master Car Builders' Association, and has done some excellent work on its various committees dealing with freight car matters. He was president of the Western Railway Club, 1909-10, and has a host of railroad friends to welcome him into his new field of endeavor.

New Books

The proceedings of the nineteenth annual convention of the Traveling Engineers' Association have been issued in book form. The book contains all the papers, together with a report of the convention, and is prefaced with a group photograph of all the past presidents of the association. It is bound in black leather and is a credit to the association.

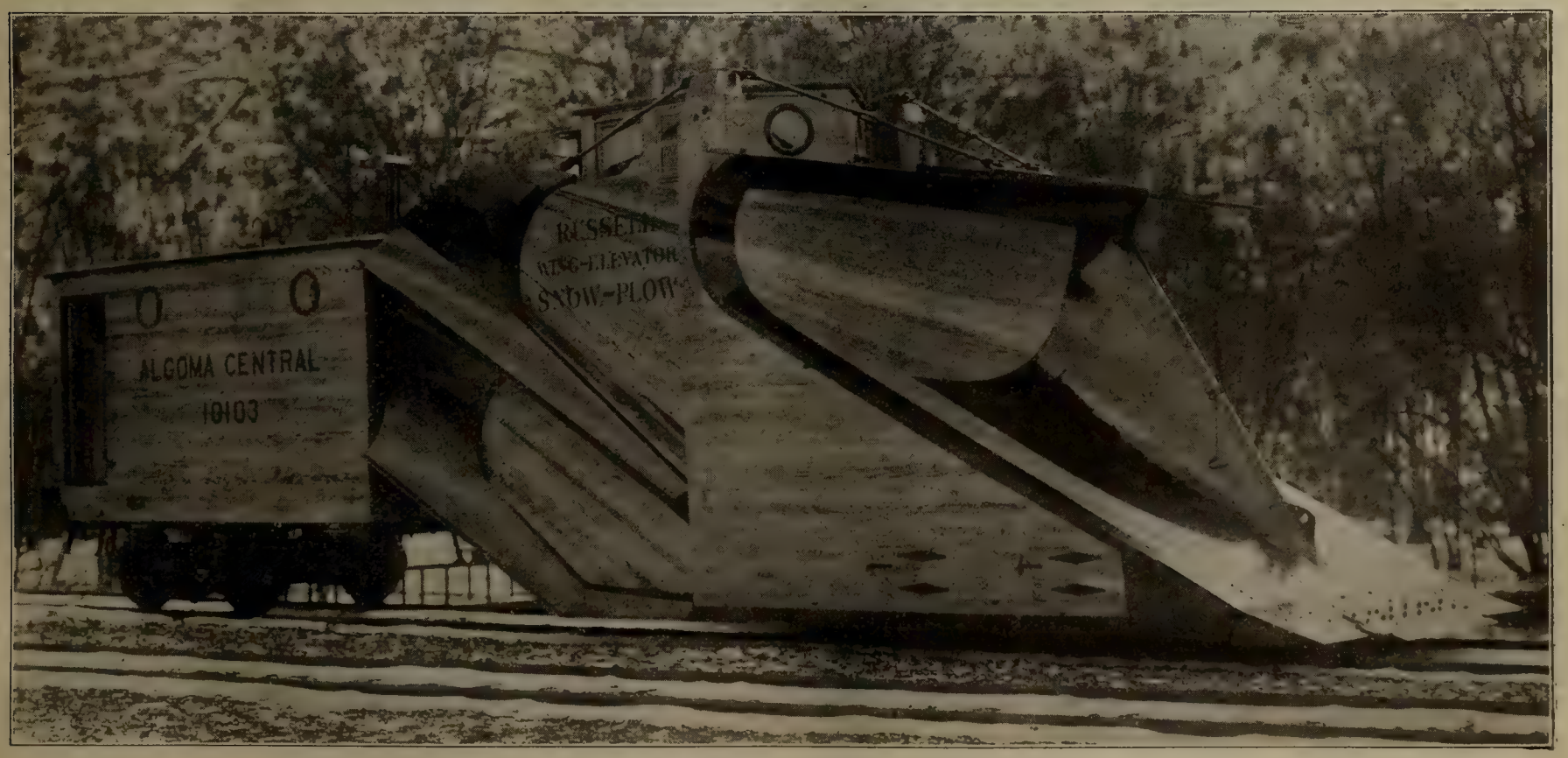
The proceedings of the nineteenth annual convention of the International Master Blacksmiths' Association have been published, and is similar in size and style to that of the Traveling Engineers' Association mentioned above.

Among The Manufacturers

SNOW PLOWS FOR EXACTING SERVICE.

The Russell Car & Snow Plow Co., Ridgway, Pa., has been rapidly expanding its volume of business with the Canadian railways by adapting its plows to meet their conditions, and the views of their operating officials. One of the new features in steam road snow plows which is held in great favor by many operating officials of Canadian roads is the drop nose, which is produced by a hinge joint in the nose of the plow, that the front section of the nose of the plow can be dropped to rest on shoes sliding on the rail, so that the cutting edge of the bit is close to the top of rail, and the flanger plate and centre portion of the nose can be dropped between the rails, thus cutting out and removing the ice and snow from between the rails. For passing obstacles such as crossings and switches the bit can be raised to make a clearance of 5 in. above the top of rail, the raising and lowering being accomplished by compressed air under control of the operator in the lookout on top of the plow. This special feature is shown in the accompany illustration of the size No. 2 wing elevator snow plow recently delivered to the Algona Central & Hudson Bay Railway at Sault Ste. Marie, Ont., Can. This plow has a width of bit of 9 ft. 4 in. and with wings extended will make a clearance of 16 ft. in width and will handle snow of a continuous depth of 12 ft., and of considerably greater depth for short distances, and if operated at a rate of speed of from fifteen to thirty-five miles per hour will easily throw the snow beyond the usual limits of the right-of-way.

The type of plow which the Russell company has been furnishing the Grand Trunk Pacific Railway for equipping its lines is a wing elevator plow with a flanger under the centre of plow. This size is the largest manufactured by this concern and has a height of mouldboard of 12 ft. 11 in., and with wings extended makes a clearance of 16 ft. in width. The wings and flanger on this plow are also operated by air under control of the operator stationed in the lookout, the air being taken from the trainline. The two illustrations herewith show the plow in action emerging from a heavy drift, and the opening made through the drift. The Russell snow plows are said now to be used on more than 100 different railroads, and are manufactured in a variety of sizes for both single and double track service. Under



Size No. 2 Plow with Wing Elevators and Drop Nose.

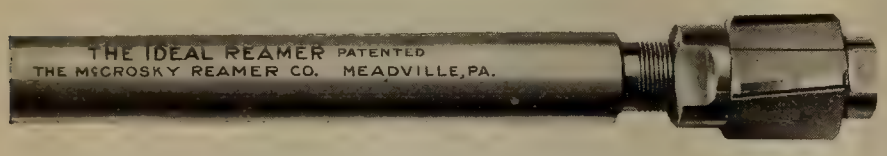
very severe conditions of deep and hard packed snow, as many as three and four locomotives are sometimes used to drive the plow through the drift and the plows are built amply strong to withstand this strain. Of the many hundred now in service some have been in use for more than twenty years, and are still in good operating condition. The various sizes of Russell plows may have the flanger installed for removing snow and ice 2½ in. below the top of rail and 14 in. outside of rail; the flanging being done in the same operation with which the snow is plowed.

The popularity of the Russell plow cannot be better described than by stating the fact that one of the leading railroads in the United States has been using this type for the last twenty years, and now has sixty-four in service. This plow is also standard on the Imperial Government Railways of Japan.

"IDEAL" MACHINE REAMER.

The illustration shows a reamer until recently made by the Hall Mfg. Co., Jackson, Mich., but now manufactured by the McCrosky Reamer Co., Meadville, Pa.

This reamer is radically different in construction from other types of adjustable reamers. It consists of two solid blocks of high-speed steel held on an arbor by two powerful



Adjustable High-Speed Machine Reamer.

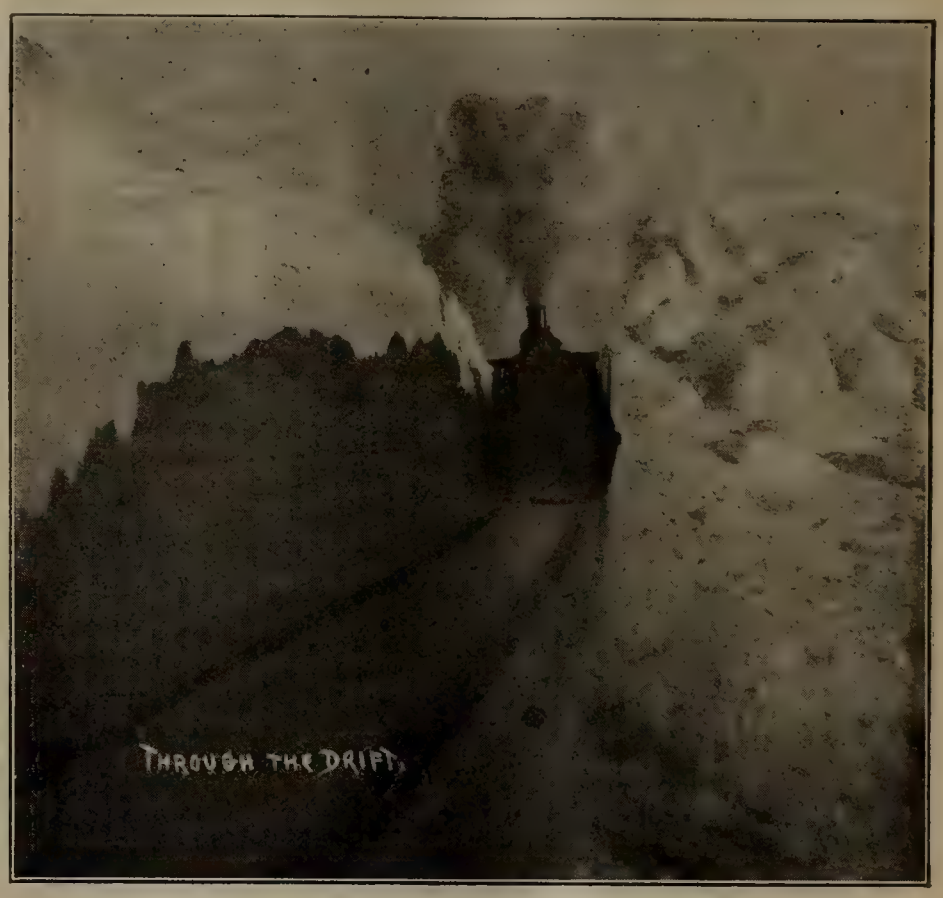
collars without screws or small parts. There are four left-hand spiral cutting edges and each tooth is milled in the solid head. Adjustment is effected by loosening the rear collar and tightening the front collar, which forces the two halves of the reamer head up the inclined surfaces of the arbor. If desired the maker will furnish ideal reamers with right-hand spiral flutes for roughing purposes.

It is stated that an "Ideal" reamer of 2 in. size will expand nearly 3-32-in. and other sizes proportionately. The manufacturer recommends this reamer particularly for any job in phosphor bronze, steel tubing, steel castings, steel forgings, or aluminum.

McKEEN MOTOR CARS FOR VICTORIAN RAILWAYS, AUSTRALIA.

The McKeen Motor Car Co., Omaha, Nebraska, recently shipped two 70-foot, 200 horse-power, gasoline motor cars to the Victorian Railways, Melbourne, Australia. This shipment required five flat cars for its transportation to Tacoma, where they will sail via the Frank Waterhouse Line. The two boxes containing the car bodies measured 70 feet in length by 11 feet wide by 10 feet high, and are said to be the largest boxes ever shipped in the history of rail or water transportation. The accompanying picture shows the motor cars boxed and loaded ready for shipment from the factory.

These cars are of the McKeen type, adapted to the special requirements of the Victorian Railways, the gauge of which is 5 feet, 3 inches. They are equipped with English standard



Path of Russell Plow.

Russell Snow Plow in Action.

coupling and buffing gear, front and rear. The center side door entrance is especially designed for handling passengers on depot elevated platforms, which prevail in Australia. They

The cars are propelled by a 200 h. p., air-starting, reversible gasoline engine. The dimensions of the engine are:

4-cycle—6-cylinder.

Russell Size No. 1 Plow Equipped with Wing Elevator and Flanger.

are built to accommodate thirty first-class passengers and forty-three second-class. Each compartment is divided into non-smoking and smoking compartments, by means of sliding doors. The second-class passengers are placed in the rear, and the first-class forward of the center side entrance and behind the ten-foot baggage room.

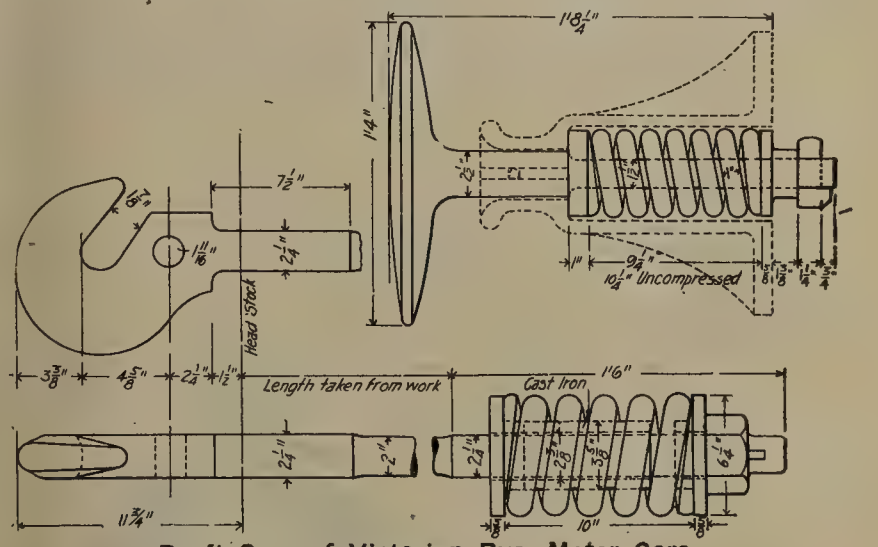
The construction of the cars is steel throughout, being built up of standard rolled sections, the center sill being an 8-in. "I" beam, and the two lower side sills 6-in. channels. The side sheets are of No. 12 Bessemer sheets, and the roof sheets No. 16 Bessemer, riveted to channels, forming posts and carlines, which are continuous from side sill to side sill, thus giving the greatest possible strength with the least possible weight. The circular windows, which are wind, dust and water proof, permit of this strong construction.

The cars are ventilated automatically, by the motion of the car, air being admitted through the intake "V," Fig. 1, passing over the car heating coils, and the foul air is exhausted by suction ventilators in the roof, "U," Fig. 1.

Lighting is by the Commercial Acetylene system, the gas

Diameter—10 ins.
Stroke—12 ins.
Horse-power—200 at 350 r. p. m.
Valves, nickel steel—4 ins. in diameter, mechanically operated.

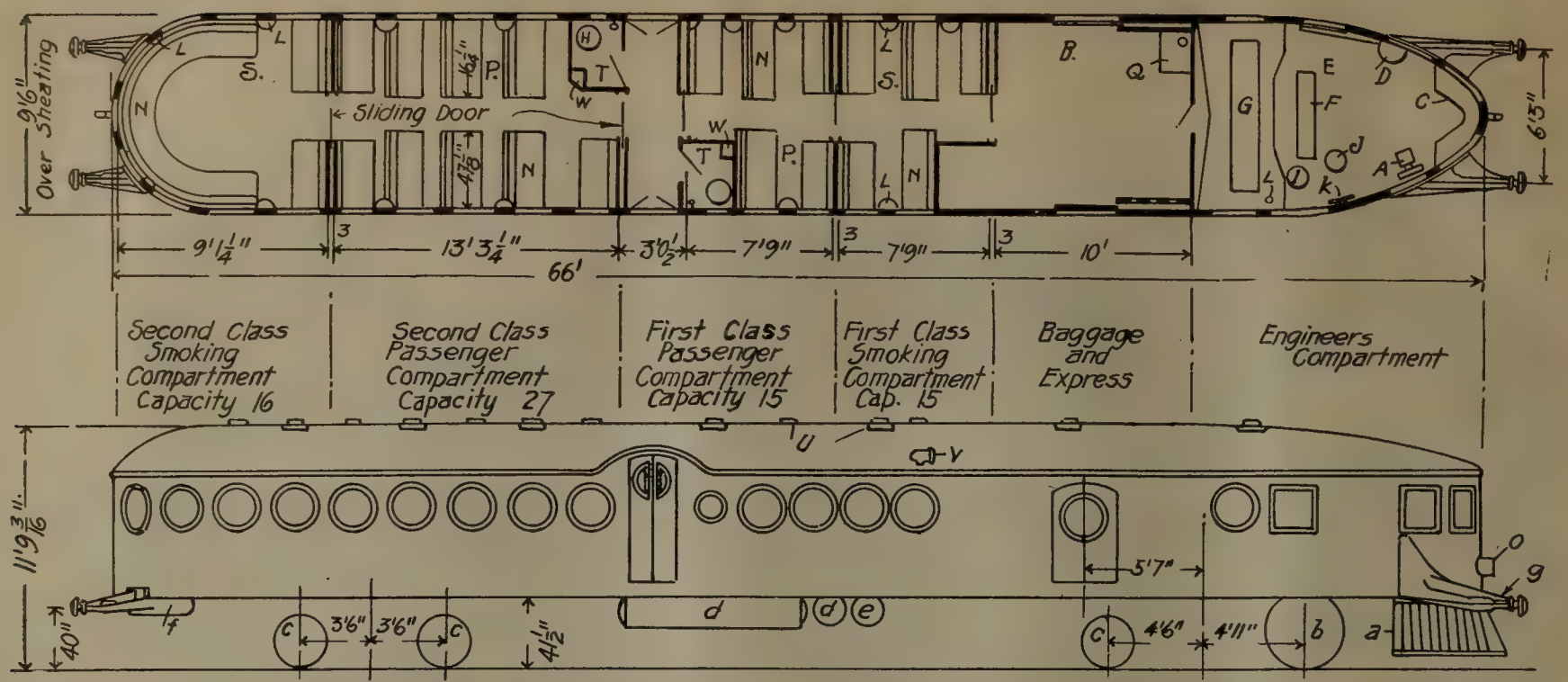
Crank shaft—.30 carbon steel, 4-in. crank pins, 5-in. main bearing.



Draft Gear of Victorian Rys. Motor Cars.

McKeen Motor Cars Boxed and Loaded for Shipment to Australia.

being carried under compression in a tank. The ignition of the motor is by both magneto and coil; the coil is supplied with duplicate sets of accumulators.



McKeen Motor Car for Victorian Rys.

Carburetor—3-in. McKeen, equipped with Cold-day starter.
Cam shaft—sliding, reversible, gear driven.

The engine is mounted on the front truck and is quite independent of the car body. The drive is direct from the engine, by means of a 5-in. Morse silent chain, the driving sprocket uniting the two halves of the crank shaft. The driving half of the friction clutch, together with the driven sprocket, are mounted directly on the main axle, the drive from the friction clutch to the axle being transmitted by means of a sliding clutch. Forty-two inch steel tired drivers are used, the wheels on the rear axle of the motor truck and both axles of the rear truck being 33-in. rolled steel.

The engine is water-jacketed, the jacket consisting of ⅛-in. copper sheet. The cooling water is circulated by a gear pump through the pilot radiators, two rear radiators and car heating coils, the latter being cut out in hot weather.

The general dimensions of these cars are:

Gauge	5 ft. 3 ins.
Length	70 ft. 0 ins.
Length, baggage compartment	10 ft. 0 ins.
Length, first-class compartment	15 ft. 6 ins.
Length, second-class compartment	21 ft. ¼ in.
Width over all	10 ft. 0 ins.
Height over all	11 ft. 9 3-16 ins.
Weight	68,000 lbs.

This Australian shipment increases the number of McKeen cars in service to 122.

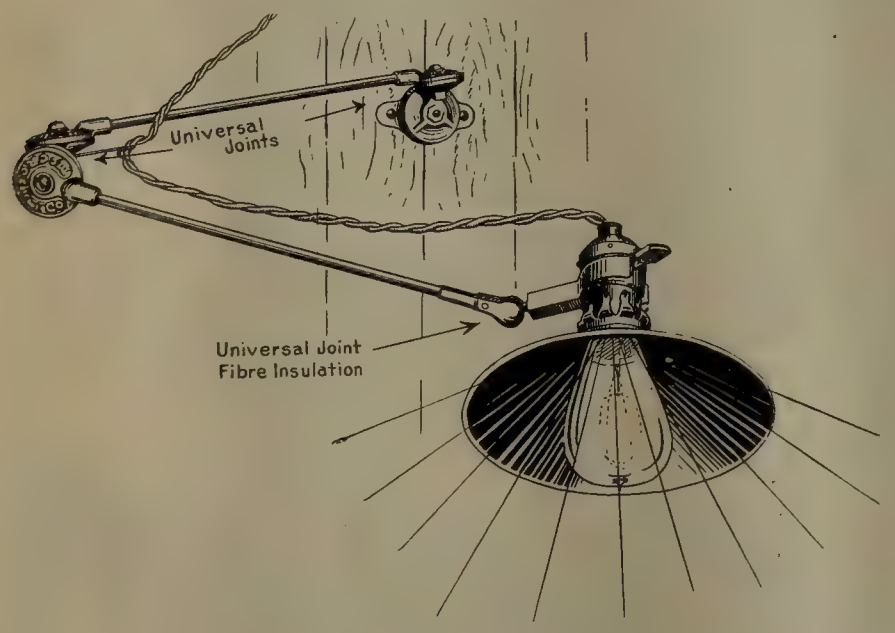
UNIVERSAL LAMP BRACKET.

The McCrosky Reamer Co., Meadville, Pa., has placed on the market a universal lamp bracket and termed it the "Searchlight." This bracket is an improvement on and an outgrowth of the Christiman bracket sold last year.

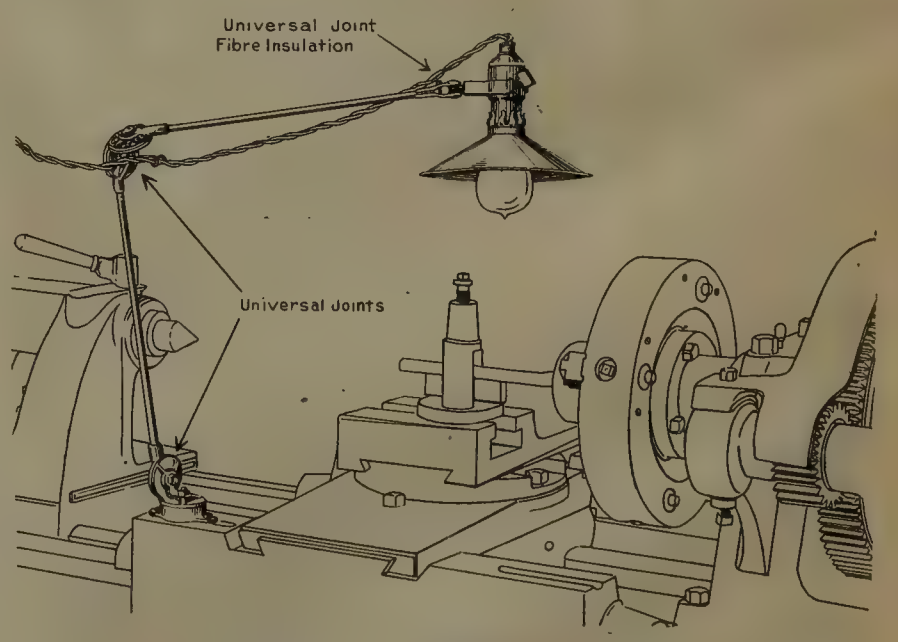
The drawings show this bracket in two applications. The use of two universal joints makes the device either horizontally or vertically movable to any position. If desired the light can be quickly removed from the spring clamp, and as easily replaced.

The universal joint in the Searchlight bracket consists of friction discs so arranged as to give both horizontal and vertical movements. Between each pair of discs is a friction washer, and the amount of friction is regulated by screws and locknuts which hold the friction uniform at any desired tension. The arms are of solid steel and the discs are malleable iron, machined to a perfect bearing on the friction washers between.

The brackets are plated by an electro-galvanizing process giving an aluminum finish which is rust-proof and very pleasing to the eye.



"Searchlight" Bracket Located on Wall.



"Searchlight" Bracket on Lathe.

New Literature

The Kansas City Chemical Co. of Kansas City, Mo., has issued a very attractive booklet descriptive of Lardoilene cutting compound for machine shop use.

* * *

Two booklets have recently been issued by the Chicago Pneumatic Tool Co. of Chicago giving descriptions and illustrations of the various air compressors made by this firm. These consist of various types of steam and electric driven compressors and also a tandem gasoline driven compressor.

* * *

The Falls Hollow Staybolt Co. of Cuyahoga Falls, O., has published a leaflet advancing seven reasons for the use of hollow staybolts. The firm has recently installed threading machines, and is now equipped to furnish individual stays.

* * *

"Connect up your factory with the sun," says the monthly house organ of the Detroit Steel Products Co. of Detroit. That phrase is certainly suggestive of Detroit-Fenestra steel window sashes.

* * *

"SKF Radial Bearings" is the title of a bulletin just issued by the S. K. F. Ball Bearing Co. of New York. It explains the construction peculiarities of "SKF" Radial Bearings and gives dimensions, speeds and capacities of the principal types and sizes.

* * *

The McCrosky Reamer Co. of Meadville, Pa., has issued a catalogue and price list of McCrosky's adjustable reamers, Wizard chucks and collets, McCrosky's expanding mandrels and searchlight universal lamp brackets.

* * *

Circular . 1198, describing alternating-current water-wheel generators has been issued by the Westinghouse Electric and Manufacturing Company of East Pittsburgh, Penn. The publication illustrates and describes the different types of generators, both vertical and horizontal, for water-wheel drive, manufactured by that company. Numerous illustrations of water-wheel driven installations are shown.

* * *

"Car Appliances" is the title of a new catalogue recently brought out by the Acme Supply Co., Chicago. A number of new appliances are shown, among which is the Acme weather-proof window, a new dust and cinder deflector, and several types of pressed steel door. The catalog is artistic and readable.

* * *

The Russell Car & Snow Plow Co. of Ridgway, Pa., has issued a catalog of Russell snow plows. These plows are made in several different types and sizes and these are shown in a number of very good illustrations. They are mounted on eight wheels and are equipped with air brakes and automatic couplers. The catalog is of timely interest.

Industrial Notes

W. J. Bixby has been appointed a receiver of the Wabash and has resigned his position as a director of the American Car & Foundry Co.

William H. Connell, Jr., mechanical engineer, has been made manager of the new office of the Hilles & Jones Co., Wilmington, Del., with office in the Henry W. Oliver building, Pittsburgh, Pa.

C. B. Flint, manager of the supply department of Manning, Maxwell & Moore, has resigned to become president of Flint & Chester, Inc., 237 Lafayette street, New York. This firm carries on a business in railway, machinists and contractors' supplies.

H. M. Perry, known as the inventor of the Perry side bearing, a master car builder of many years' experience and until recently a representative of the Joliet Railway Supply Co., has been appointed a representative of the Chicago Car Door Co., with offices in the Monadnock Bldg., Chicago. Mr. Perry has recently attracted considerable favorable comment by writing a series of articles called "Reminiscences of a Master Car Builder," published serially during 1911 in the *Railway Master Mechanic.*

The Pressed Steel Car Company, Pittsburgh, Pa., has removed its office from St. Louis, Mo., to the Old Colony building, Chicago.

The Baldwin Locomotive Works recently acquired the right to build the Garrett type locomotives for service in the United States and Canada. The special feature of these locomotives is that they are of high capacity and will operate on lines having sharp curves.

Mr. E. L. Messler, who for the past 12 years has been general superintendent of the Jones & Laughlin Steel Co.'s Pittsburg coke ovens and blast furnaces, has tendered his resignation, effective January 1, to accept the position of assistant to the president of the Riter-Conley Manufacturing Co., Pittsburgh.

The John F. Stevens Co. has been organized in New York with a capital stock of $2,000,000 and proposes engaging in railroad construction work. J. F. Stevens, ex-president of the North Bank road and the Hill lines in Oregon, is president. A large portion of the stock is held by the United States Realty & Investment Co., of which the John F. Stevens Co. will be an auxiliary concern. It is understood that arrangements will be made for extensive railroad work in any part of the United States.

The L. S. Starrett Company, which has one of the largest manufacturing establishments of fine mechanical tools in the world, has recently increased its capital stock to $3,500,000, of which $1,500,000 is to be six per cent cumulative preferred stock and $2,000,000 common stock. The officers of the company are: L. S. Starrett, President; F. A. Ball, vice-president; F. E. Wing, treasurer and secretary; W. G. Nims, assistant treasurer; with a board of nine directors consisting of the officers named and M. B. Waterman, Augustus P. Loring, John A. McGregor, J. H. Drury, and W. B. McSkimmon. The last four named are officers of the Union Twist Drill Co., the second largest machine factory in Athol. The Union Twist Drill Co. becomes a stockholder of the L. S. Starrett Co. and as such has representation on the board of directors, which is increased from five to nine. The L. S. Starrett Co. was incorporated in 1900, succeeding to the business established by L. S. Starrett in 1880 and conducted by him individually up to the time of its incorporation. The capital stock of the incorporation was $100,000 in 1900, since which time the business has increased far out of proportion to the original capital. L. S. Starrett continues in active control of the business.

The Jerome Metallic Packing Co., Chicago, has moved its main offices to the Railway Exchange, where larger floor space has been secured. William H. Dickinson, for 14 years connected with the Griffin Wheel Co., Chicago, has accepted a position with the Jerome company, with special charge of the sales department. The company has secured the sole rights of manufacture and sale of the Stickley pneumatic track sander and will also handle the product of the Ruby Manufacturing Co., Jackson, Mich., consisting of portable galvanized sectional steel buildings, sectional steel bill-boards, and for railway right of way bulletins and signs.

Recent Railway Mechanical Patents

CAR-VESTIBULE CONSTRUCTION.

1,007,979—Max M. Schneider, assignor to the Pullman Co., Chicago, Ill.

Patented Nov. 7, 1911.

This patent, owned by the Pullman Co., relates to an improved construction of the end portions or vestibules of metal cars. The illustration shows a sectional plan view of the end of such car.

CAR UNDERFRAME.

1,009,751—Clarence H. Howard, of St. Louis, assignor to Double Body Bolster Co., of St. Louis, Mo.
Patented Nov. 28, 1911.

This is an improved cast steel underframe comprising a body bolster and end sill and connecting members all formed in one piece. As clearly shown in the illustration the threshold plate 11 of the door is formed integral with the end sill and has a flange 12 which overlies the end of the flooring.

RAILROAD CAR BRAKE.

1,010,496—Clarence H. Howard and Harry M. Pflager, of St. Louis, assignors to Double Body Bolster Co., of St. Louis, Mo.
Patented Dec. 5, 1911.

In this improved brake rigging the main pull lever 7 is connected at its upper end both to the push rod 5 of the brake cylinder and to the pull rod 15 of the head brake gear. In this way the brake may be applied with the same leverage either by hand or by power.

GONDOLA CAR.

1,010,625—Harry S. Hart, Chicago, assignor to Rodger Ballast Car Co., of Chicago, Ill.
Patented Dec. 5, 1911.

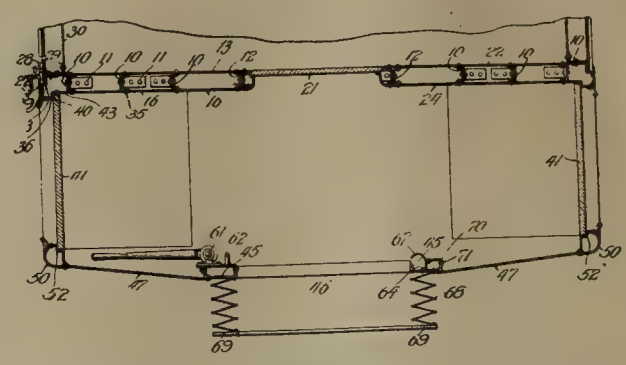
This invention relates to an improved underframe which is especially adapted for use in connection with hopper bottom gondola cars. It also relates to improved means for adjusting the height of the sides and ends of such cars. The illustrations show a longitudinal and transverse section through the car. For a better understanding of the construction those interested are referred to the complete patent which contains ten figures.

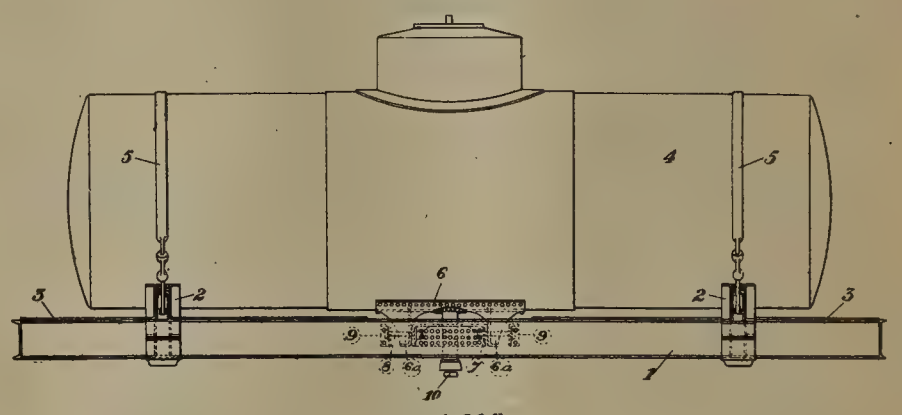
TANK CAR.

1,011,216—Charles A. Lindström, of Pittsburgh, assignor to Pressed Steel Car Co., of Pittsburgh, Pa.
Patented Dec. 12, 1911.

This is an improved tank car so constructed that the tank may be readily removed from the underframe. The tank is secured to the frame at each end by means of detachable straps 5 and in the middle it is held in place by means of a bracket 6 secured to the tank which engages a casting 7 riveted to the center sills, as clearly shown in the sectional detail view.

1,007,979.





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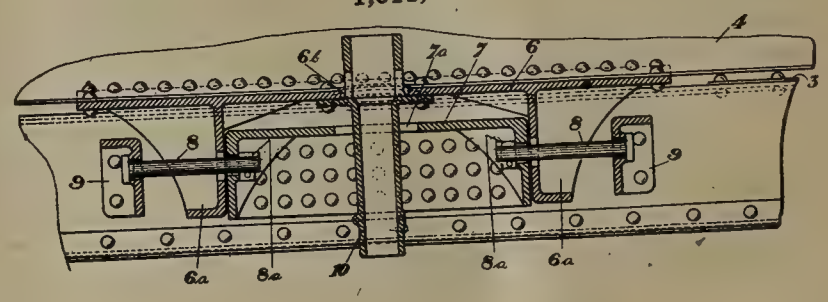

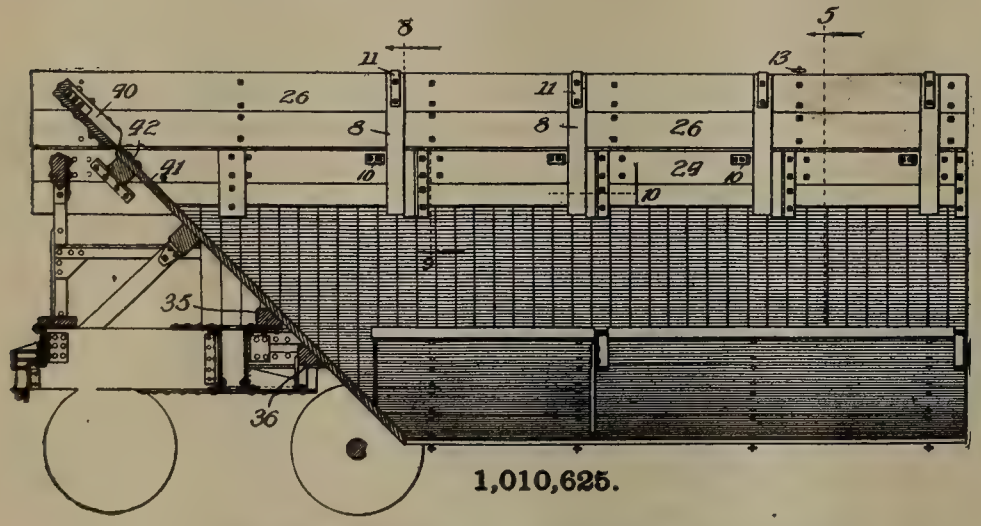

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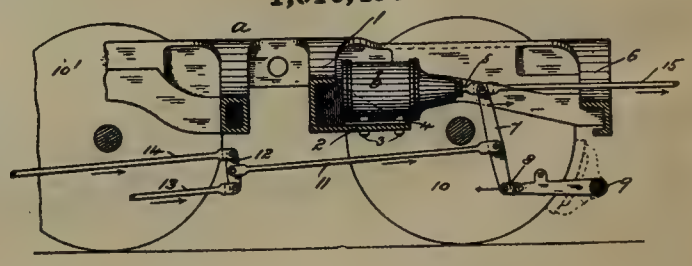

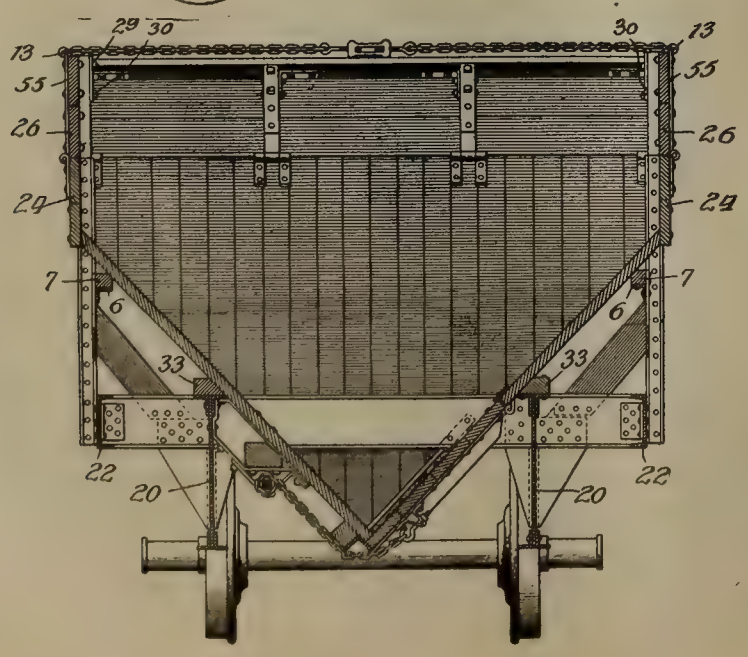

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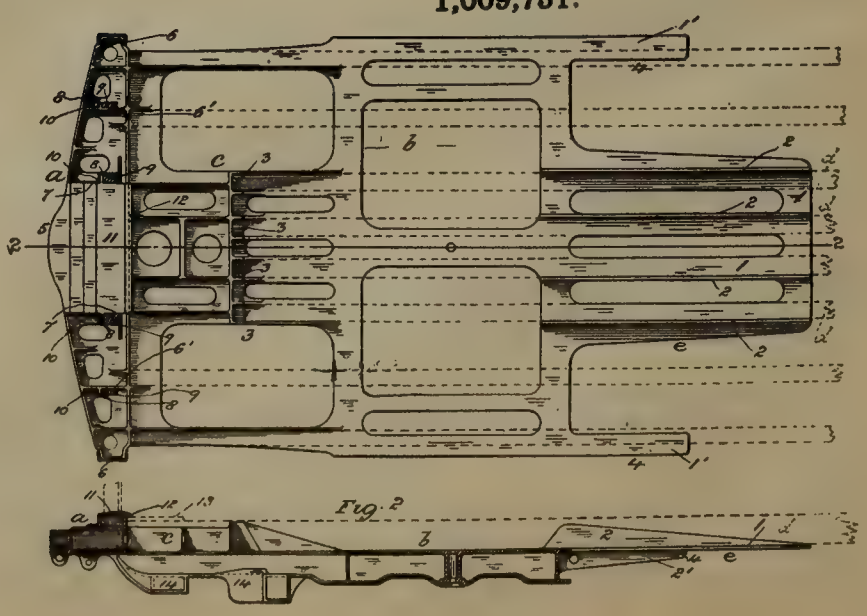

RAILWAY MASTER MECHANIC

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Published at the World's Greatest Railway Center
Established 1878

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The boiler inspection law became effective July 1, 1911, at which time a chief inspector and forty-seven district inspectors were appointed. According to the recent report of the Interstate Commerce Commission, the first report of the chief inspector was very satisfactory, showing that for the first three months following July 1 there were 6 deaths and 32 injuries due to boiler accidents as against 12 deaths and 260 injuries during the previous three months. However, we shall be able to judge the results of boiler inspection more clearly at the end of a year or two. The Interstate Commerce Commission report also states that standardization of operating rules would contribute greatly towards safety of railway travel, inasmuch as operatives are constantly changing from one road to another. In support of the statement, mention is made that navigation rules are the same throughout the world and that the necessity for standard operating rules is just as apparent.

OVER-CYLINDERED LOCOMOTIVES AND THE SUPERHEATER.

Probably one of the most frequent causes of inefficiences in locomotives is small boiler capacity. This difficulty is as frequently met with in late designs as in those of earlier type, and most frequently is it found in the Mallet. No doubt a valid reason for this fact is lack of proper consideration and allowance for the simpling feature. Previous compound types have entered service which does not demand the large percentage of simple operation which is almost always expected of the Mallet. In pusher service or in handling freight over mountainous districts, those in charge of this class of power have found that what they consider necessary simpling results in more or less excessive drains on the boilers. It cannot be doubted that this is often due to improper handling of the engines, owing to lack of thorough instruction; neither is it to be doubted that in some cases the remedy is not so easily to be applied.

The claims of those who have been responsible for the development of the locomotive superheater have been pretty well substantiated by thorough and impartial service tests in all its applications. The latest of these series of tests, that conducted by the New York Central, has supplied information, heretofore lacking, which concerns the application of the superheater to the Mallet. A large number of points of difference have been finally settled, nearly always in favor of the supporters of high degree superheat. Incidentally the brick arch has secured a share of the credit which it deserves through this same series of tests, and its place as a prime factor in the increase of boiler efficiency, has been determined.

Considering the substantiation of these facts and also considering the comparatively small cost of the improvements mentioned, it would seem that the continued operation of locomotives lacking in boiler capacity, without them, could be considered nothing less than negligence on the part of those responsible. Reduced boiler pressures and larger cylinder diameters have followed the use of superheaters because any advantages gained by the use of high pressures with saturated steam are secured just as practically and automatically in combination with the other advantages of superheated steam. In the case

of the overcylindered, saturated steam locomotive, the feasability of securing by means of the application of a superheater, increased hauling capacity and general efficiency, is well substantiated. The use of the brick arch surely follows as a matter of course.

EMPLOYERS' LIABILITY DECISION.

The employers' liability law, enacted by Congress in 1908, was declared constitutional by the Supreme Court in a decision handed down during the middle of January. The law of 1908 took the place of one previously passed by Congress but declared to be unconstitutional. The decision as to the present law, however, was unanimous and the law supersedes all state legislation covering the same field as applied to interstate commerce. It makes the employer liable for accidents caused by the negligence of an employee (the fellow servant doctrine), and greatly curtails the defenses of the employer in the cases of "contributory negligence" and "assumption of risk." The decision of the Supreme Court is positive and plain in stating that Congress has the right to enact legislation defining the liability of carriers engaged in interstate commerce.

Legislation of this sort has been enacted in practically all foreign countries and it must eventually result in good, not only to the community at large, but to the carriers as well. About a fourth of our states have laws limiting the old time defenses of the employer and the right to do this has now been firmly fixed by the highest court of the land. The railroad employee is a part of the company; now more than ever is the company responsible for its employees. The past month saw the appointment of a superintendent of safety on the Burlington; twenty years ago a superintendent of safety would have been about as logical as a superintendent of swearing. By this time most of our roads are doing organized work towards the propagation of safety. The Chicago & North-Western has the slogan "Safety First" and it might well have made it "Safety First and Always," for railroads are operated to make life of more value and not of less value. A number of roads in buying machine tools make the item of safety one of the important points to be considered, and now that the employer's liability is increased, it might be well to note that it is up to machine tool builders and others to see that their products have been made as safe as possible, and to let their customers know it. The machine tool which is efficient and at the same time is safeguarded is bound to command the interest of those making railway purchases.

However, a stricter definition of employers' liability does not necessarily mean a more efficient system of workmen's compensation, for under the national law, though the rights of the employee are more firmly established, the court must, in cases of last resort, fix the amount of compensation. A bill providing for a definite scheme for workmen's compensation, which is now being worked out by a joint committee of Congress, should go hand in hand with the federal employers' liability law, as it does in a number of the state acts. It will allow the carriers to know just how much they are liable for, and it will allow the employee to know what he may expect. As it is, he who needs compensation most, is least able to fight for what he should have. The recent decision puts this sort of legislation on a firmer basis and should clear the way for a comprehensive scheme of compensation.

EDISON AND RAILWAY ELECTRIFICATION.

Thomas A. Edison has advanced a plan for electrifying crowded railway terminals by means of the storage battery system. If newspaper accounts are to be credited, his assurances of the success of his system have been of the boldest, and two railways have tentatively agreed to a trial. After a conference with Illinois Central officials, Mr. Edison freely gave information to Chicago newspaper reporters, to the effect that several locomotives would be built to operate on the storage battery principle and placed in service on that road in its Chicago terminal. The inventor plans to use a tender to carry his batteries much as steam locomotives haul water and coal. These tenders will be charged at a charging station and picked up by the locomotives as needed. It is stated that the batteries to be used can be charged in one hour or less, and that the power of the locomotives can be made equal to those of the largest steam locomotives in service. The Edison-Beach car, which will be tried out by the Chicago Great Western for branch line service, is equipped with batteries which cannot be charged in so short a time by several hours.

Owing to Mr. Edison's no less than marvelous success in past years as an inventor, he is looked upon by the masses of the people of this country as no less than a wizard and consequently his assurances of the success of his latest efforts are credited by them to the fullest extent. Owing to this fact, and following Mr. Edison's statement, small sympathy is extended, by the people who are behind the movement to push the electrication of terminals, to those conservatives who wish something more than bare assurances before taking a radical step of this nature. It seems hardly possible that even Mr. Edison, after such a superficial insight into the local situations, has not underestimated the difficulties incident to the change of motive power. Perhaps it might have been more satisfactory all around if the engineers now engaged in the study of the subject of the electrification of the terminals at Chicago and other points, had been given a chance to go into Mr. Edison's plans thoroughly before the unreserved assurances had been made public.

D. R. MacBain, superintendent of motive power of the Lake Shore, has recently been granted a patent on an improved method of manufacturing locomotive boilers. The essential feature consists in placing a compressive strain upon the boiler tubes, by mechanical means, to oppose the tensile strain induced in service in the boiler shell. This is done by springing the tubes in so that they have a slight curvature and securing the ends in the tube sheets, thus providing against the tensile strain.

In a recent address, David H. Browns, superintendent of the Lake Superior Corporation, said. "Success in life means two things, greater earning ability and greater enjoyment capability. The end of life is happiness. Happiness arises not merely from greater earning power but from greater capacity for enjoyment."

Dodging bullets never saved a life. Dodging responsibility never made one. Tomorrow something may strike you. You can't dodge it. Then pay attention to where you're shooting today. If tomorrow it does strike you, let it find you standing firmly on your feet that it may not stagger you. If number 310 must be out of the shop by four o'clock—take the responsibility. It is up to you—see that you are up to it. You will be better prepared to meet the next jolt. Responsibility like the bullet travels in a straight line; if you are in its path, it will leave its mark even though you try to dodge. The more you dodge—the less you shoot. The man who has made his life worth while has done it by shooting, not by dodging. John Boyle O'Reilley expressed it well in this way:

"Soldier why do you shrink from the whiz of the angry lead?
The bullet that whizzed, is past, the approaching ball is dumb.
Stand straight, you cannot shrink from fate, let it come.
A comrade in front will hear it whiz when you are dead."

IDEAS PURCHASED.

Some time ago the Pennsylvania Company announced that it would pay its men for valuable ideas. The first results of the experiment have just been made public. The response was immediate. As was expected, the men in charge of minute detail saw ways of increasing efficiency which escaped the general directors of the work. Suggestions came in from all quarters. Many of them proved to be of real value and their authors were rewarded in cash.

A clerk in one of the roundhouses won a premium by submitting a plan for increasing economy by the further use of carbon sheets which remain in repair card books, after the cards have been filled in and removed. He devised a way of using this carbon paper in connection with one of the company's forms for ordering material from the store houses.

Another of the schemes considered worthy of remuneration came from a tinsmith in one of the shops. He discovered an improved method for fastening in engine cabs the boxes which contain flags, torpedoes and medical case. By standardizing the heights of coal gates on locomotive tenders, a fireman saw a way to minimize the loss of coal through vibration. He was paid for the idea.

At one of the terminals, an appliance for cleaning and sterilizing drinking cups used in coaches was perfected by a car inspector whose duties are in connection with the care and equipment of passenger cars. It was an undoubted improvement over the old method and its originator received payment for it.

Although a great many worthless suggestions come in, officials say that the saving effected by those which are adopted makes it very much worth while to investigate them all. Aside from these direct benefits, there is much indirect gain in the added interest employes take in their work, and in the watchfulness and originality which is developed.

The Santa Fe de Luxe extra fare train between Chicago and California has buffet and dining cars equipped with Duntley air washers. These washers, which are electrically driven, take in air through a vent in the deck. The dust and cinders are removed in the washers, and the air is then forced into the cars through a series of ventilators placed just beneath the deck sash. The washers are packed in ice and the apparatus is another step toward better ventilation in our cars.

Oil burning engines are to be used on the lines of the Canadian Pacific in British Columbia. About 75 engines, including a number of Mallets, are to be converted from coal burners to oil burners. The use of oil as a locomotive fuel throughout the west is on the increase, the Great Northern having just recently converted a large number of engines on its western lines. The Tehuantepec National Ry. in Mexico is also using a large number of oil burners.

Key West, Fla., was connected by rail to the continent on January 20, this date marking the opening of the Florida East Coast Ry. from Knights Key to that point. This road is a wonderful example of modern engineering as the last fifty miles is practically built out over the ocean, touching here and there some of the Florida Keys. Through Pullmans will be run from New York to Key West and as the latter place is only 90 miles from Havana, it is predicted that ferrys will eventually enable one to make the entire trip to the island without change.

GROUCHES.

The man who indulges in either grouch or graft is a goner, and all good railroad men know it.—*Elbert Hubbard.* As a general thing, we think that about fifteen minutes in a barber shop and a week's work in the erecting shop would be a good thing for Elbert, but we do think that statement hits pretty straight. You can't afford to indulge in a grouch until you are fifty, and if you put it off until them, you won't want to. The grouch generally seems to wish he was dead, and generally other people wish he was too. Of course, you haven't a grouch, but if you should ever feel one coming on, you might stop to consider that living isn't such a bad occupation after all. As to graft—there are numerous instances to prove this point. Are you a good railroad man?

The Baltimore & Ohio is understood to be planning to construct a branch line, primarily for the purpose of transporting material and machinery for the hydroelectric development on the Cheat River. It is said that the road will be constructed at first as far as Beaver Hole, where one of the dams is to be located, and then will be extended through Preston county, W. Va. This company is also stated to have taken over the Hampshire Southern, a 38-mile line, built two years ago, extending from Romney, W. Va., to Moorfield at Petersburg. It is probable that the line will be extended to Franklin, and also in Hyland county, Va.

It is now stated that the officials of the Chicago, Burlington & Quincy have reached a decision not to extend the lines of the company south of the Ohio River into Southeastern territory.

Mikado Type Locomotives, Erie R. R.

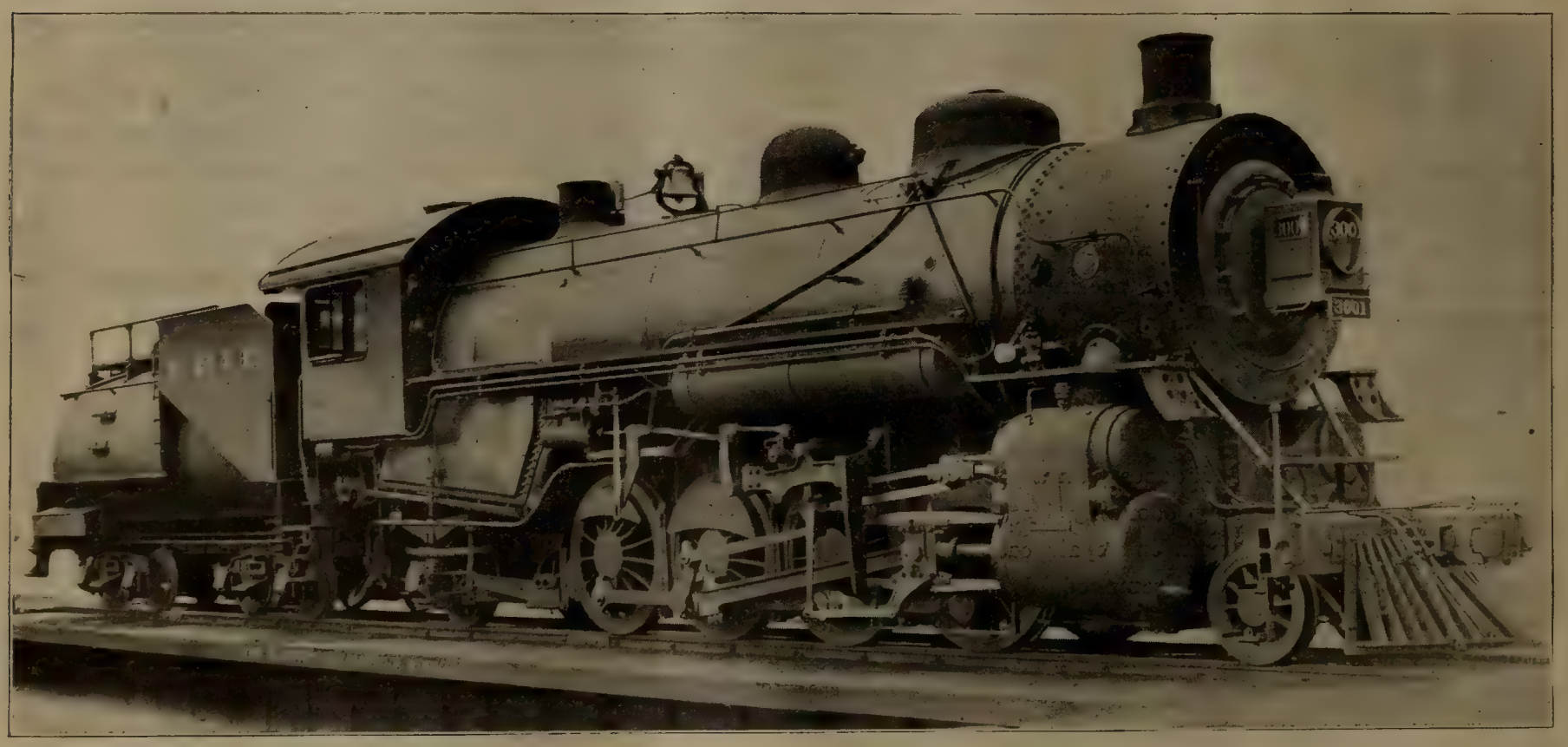
The Erie Railroad has recently received from The Baldwin Locomotive Works, twenty Mikado type locomotives for service on the Cincinnati division. These locomotives are being introduced in order to increase the capacity of the division and relieve freight congestion. The average load per pair of driving wheels is very nearly 60,000 pounds, and in point of total weight the locomotives are the heaviest of their type thus far completed by the builders. They are built in accordance with specifications furnished by the railroad company and are designated as class N-1.

Compared with the class H-21 consolidation type locomotives used on this road, the new Mikado type locomotives show an increase in tractive force of 35 per cent., in weight on driving wheels of 31 per cent., and in total equivalent heating surface of 83 per cent. The H-21 locomotives use saturated steam while the N-1 engines are equipped with fire-tube superheaters. In making the above comparison each square foot of superheating surface is considered equivalent to 1½ square feet of water evaporating surface. On the basis of water evaporating surface alone, the N-1 locomotives show an increase of 33 per cent. over the class H-21, and this is practically in proportion to the increase in tractive force. Therefore the increase in relative boiler capacity, measured on a heating surface basis, is provided by the superheater, and is approximately 50 per cent. This means increased hauling capacity for the new engines plus the added advantage of taking the larger tonnage at a higher speed than could be maintained by the class H-21 locomotives.

The boilers of the Mikado type locomotive present a few features that are worthy of mention. The firebox is radially stayed, and the front end of the crown is supported by four transverse rows of flexible bolts, which are used instead of the customary arrangement of T-irons and expansion links. The depth of the throat, measured from the under side of the barrel to the botom of the mud ring, is 25 inches. This provides ample room for the brick arch, which is supported on four 3-inch water tubes. The superheater is of the Schmidt type. It provides 1,050 square feet of superheating surface, and the elements are located in 36 tubes each 5½ inches in diameter. The dome base and body are flanged from a single piece of steel plate. The longitudinal seams are all placed on the top center line. They are welded at the ends, and have diamond shaped welt strips inside.

The frames are of vanadium cast steel, with back sections of hammered iron. The front frames are single and are cast in one piece with the main frames, which are six inches wide, and measure 7 inches in depth over the pedestals. The rear frames are in the form of slabs and are 2¼ inches wide. The equalization system divides between the second and third pairs of driving wheels. The spring links are here held by pins which pass through lugs cast in the frames.

The steam pipes in these locomotives pass out through the sides of the smoke box, and deliver steam directly to the steam chests. The steam distribution is controlled by 16-inch piston valves which are driven by Baker gear. The valves are set with a maximum travel of 6 inches and a constant lead of ¼ inch. The steam lap is 1 inch, and the exhaust clearance 1-16 inch. The valve motions are controlled by the Ragonnet power gear.



Mikado Type Locomotive, Erie R. R.

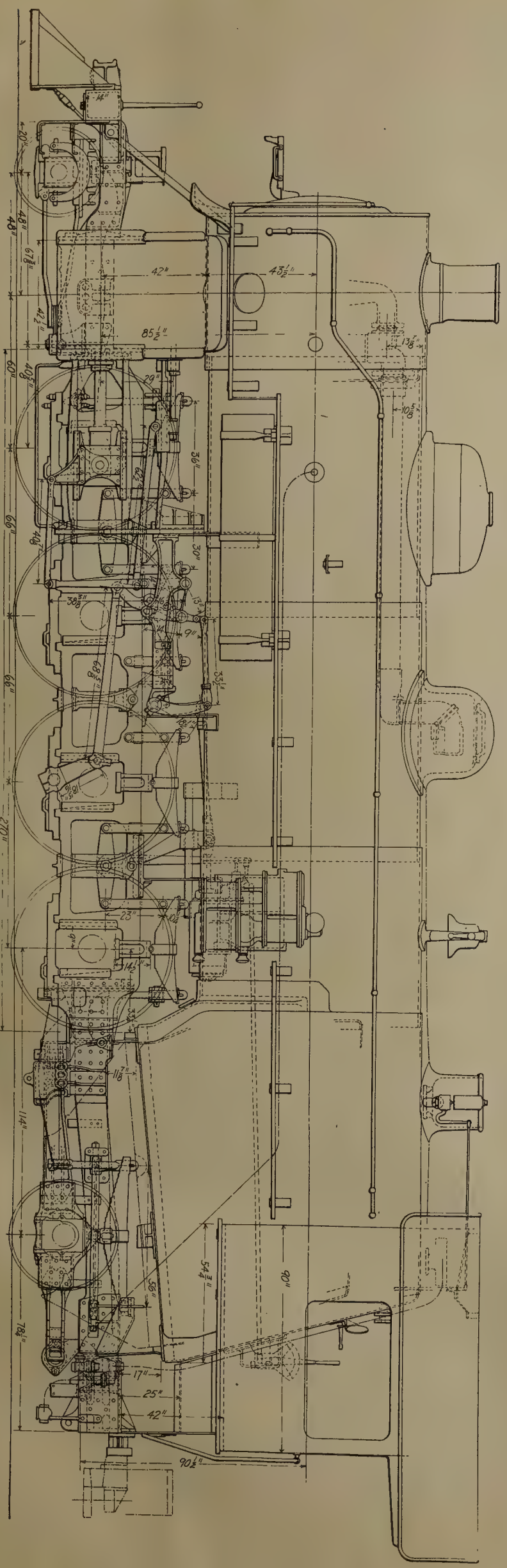
The tender is of the Vanderbilt type, with capacity for 9,000 gallons of water and 16 tons of coal. The tank has a diameter of 8 feet 9 inches, and the frame is composed of 6 x 4 inch angles, with steel bumpers. The trucks have cast steel side frames and steel tired wheels.

These locomotives have a ratio of adhesion of 4.12. The weight on drivers is thus fully utilized, and as has been pointed out, the boiler capacity is sufficient to insure free steaming. The locomotives have been specially designed to meet difficult operating conditions, and preliminary trials indicate that their performance will be most satisfactory.

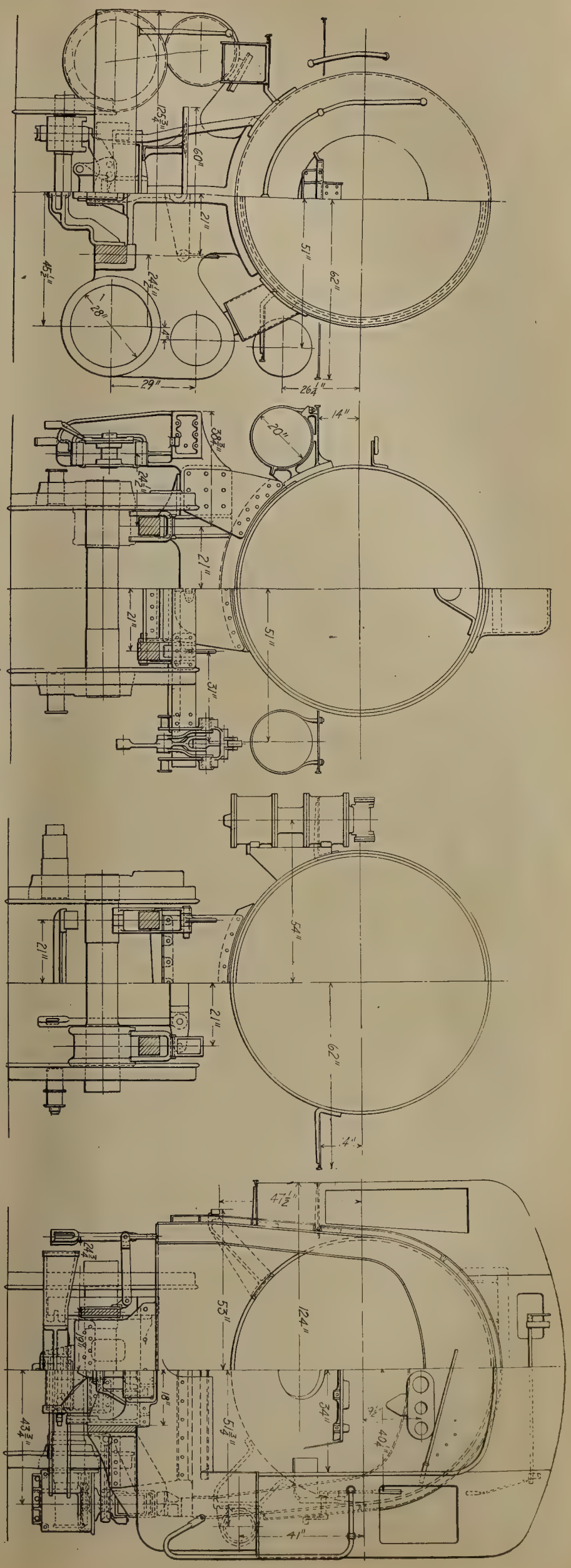
The locomotives are equipped with Schmidt superheaters with a superheating surface of 1,050 square feet.

Following is a table of weights and dimensions:

Gauge	4 ft. 8½ ins.
Cylinders	28 x 32 ins.
Valves	Balanced piston



Mikado Locomotive for Erie R. R., Built by Baldwin Locomotive Works.



Sections of Baldwin Mikado Locomotive, Erie R. R.

Boiler—	
Type	Straight
Material	Steel
Diameter	84 ins.
Thickness of sheets	15/16 ins.
Working pressure	170 lbs.
Fuel	Coal
Staying	Radial
Fire Box—	
Material	Steel
Length	120 ins.
Width	84 ins.
Depth, front	88½ ins.
Depth, back	72¾ ins.
Thickness of sheets, sides	⅜ ins.
Thickness of sheets, back	⅜ ins.
Thickness of sheets, crown	⅜ ins.
Thickness of sheets, tube	⅝ ins.
Water Space—	
Front	6 ins.
Sides	6 ins.
Back	6 ins.
Tubes—	
Diameter	5½ and 2¼ ins.
Material	5½ in., steel, and 2¼ in., iron
Thickness	5½ in. No. 9 W. G., and 2¼ in., 0.125 in.
Number	5½ in., 36; 2¼ in., 232
Length	21 ft. 0 in.
Heating Surface—	
Fire box	188 sq. ft.
Tubes	3936 sq. ft.
Firebrick tubes	31 sq. ft.
Total	4155 sq. ft.
Grate area	70 sq. ft.
Driving Wheels—	
Diameter, outside	63 ins.
Diameter, center	56 ins.
Journals	11 x 14 ins.
Engine Truck Wheels—	
Diameter, front	33½ ins.
Journals	6 x 12 ins.
Diameter, back	42 ins.
Journals	8 x 14 ins.
Wheel Base—	
Driving	16 ft. 6 ins.
Rigid	16 ft. 6 ins.
Total engine	35 ft. 0 ins.
Total engine and tender	66 ft. 10½ ins.
Weight—	
On driving wheels	236,950 lbs.
On truck, front	30,200 lbs.
On truck, back	54,900 lbs.
Total engine	322,050 lbs.
Total engine and tender, about	485,000 lbs.
Tender—	
Wheels, number	8
Wheels, diameter	33 ins.
Journals	6 x 11 ins.
Tank capacity	9000 gals.
Fuel capacity	16 tons
Service	Freight

DOUBLE-CUTTING PLANING MACHINES.

The discussion upon the virtues of double-cutting planing machines at the Institution of Mechanical Engineers on Friday last presages a new era for this hitherto much avoided machine. Mr. J. Hartley Wicksteed, in a paper at the November meeting, described double-cutting planing machines of different kinds, and their capabilities. An abstract of this paper has been given in these pages. One of these machines was described as being driven by the ordinary method of belt from a line shaft, with fast and loose pulleys, and the paper set forth the speeds and powers that can be obtained from a machine of that kind. Another one was a double-cutting machine specially suitable for cast iron and driven by a reversing motor with a Vickers form of equipment. Yet another was fitted with a reversing equipment made by the Lancashire Dynamo and Motor Company, and the speeds that can be obtained and the cuts given were set forth. Finally, a machine was described driven by a continuous running motor, and reversed without fast or loose pulleys, but by a system of jockey pullers. This latter is particularly favored by the author.

Whilst there was in the discussion a very general consensus of opinion that double-cutting planing machines had been neglected through prejudice, Mr. Wicksteed took a very impartial view of this matter, and differed somewhat from this opinion. Conservatism and prejudice did not, he thought, explain the whole situation. There would have been a fortune in the application of double-cutting toolholders to existing planing machines, but for the fact that it is no use putting these on unless they do more work, and they would not do this unless there were a double feed. If the feed were simply split between the two tools, then no good purpose was served. On this point, also, Mr. L. Pendred suggested that Mr. Wicksteed himself had been, by reason of the great improvements he had effected in ordinary planing machines, one of the greatest enemies of double cutting. Recent improvements in the increase in the rate of the return had rendered it not nearly so essential to cut on the return stroke as it was in the old days. This same speaker, after calling attention to the fact that on the return stroke, when cutting, there was a certain amount of pulling motion, instead of "pushing," which had a tendency to lift the saddle, suggested the possibility of there being no need for the electric drive. These introduced complications, and did not give any great advantage compared with belt drive. Mr. R. W. Allen did not think there was a prejudice against double cutting, *per se,* but attributed its little use to "fashion."

When an efficient double-cutting planing machine was put on the market it would have a very large sale. The prejudice against double cutting was put down to want of consideration of the subject in a fair and square manner, by another speaker.

This gentleman (Mr. Walter Deakin, not a maker of planing machines) is a proselyte to Mr. Wicksteed's efforts to make double cutting more or less universal. He introduced to the meeting a new form of attachment for double cutting, which, although he himself considered it would get over many of the obstacles which have hitherto existed, one or two subsequent speakers characterized as an old device. The principle of the attachment is a semi-rotary motion, after that of the Whitworth attachment. In this case, however, the work is done by one tool instead of two, thus avoiding having to turn the toolbox all the way round. Provision is made for adjusting the relative angle of the tool, which has a cutting edge in both directions, and the device is such that not only can ordinary surfaces be cut, but side cuts and undercuts as well. He said he had been able to heat a milling machine in undercutting, being able to undercut a slot without having to lift the tool out of the slot. This arrangement came in for a certain amount of criticism, there seeming to be a preference for two tools.

A pleasing feature of the debate from the author's point of view was that those details which he had come specially prepared to defend were not attacked. He had anticipated having to produce further evidence as to the power of transmission, with regard to the tightening and loosening of the

belts, and the cuts taken off with various horsepowers. In reference to the advantage between electric drive and jockey pulley reversal, this was specially pronounced on short cuts. The armature of the electric drive was rather a heavy item which had a good deal of kinetic energy revolving at a good speed, and it had to be reversed. A pulley made of aluminum or wood weighed perhaps one-tenth of this, and it had only, therefore, one-tenth of the kinetic energy which had to be arrested and then accelerated. On short cuts of, say, one foot, he maintained that it was possible to take 30 cycles with a belt drive against 20 with any form of drive in which there is a heavy armature. Many people did not care about time, so long as they were clear of belt, "but," added Mr. Wicksteed, naively, "they have not had experience of my belts." He dismissed the point as to the "pulling" action on the return stroke by saying "there is plenty of strength to withstand it; they were not trying to test the ultimate strength of the machine."—*Mechanical World.*

USE OF HIGHLY SUPERHEATED STEAM IN LOCOMOTIVES.*

By Gilbert E. Ryder.

Among all recent improvements in design and construction of the locomotives, the use of highly superheated steam is attracting the most attention among motive power and transportation departments. The interest displayed by railroad men in the use of superheated steam is not, as it was a few years ago, interest in a new device accompanied with the wonder whether or not it would be successful, but rather an interest of wonder at the success of the device shown by the results that have been obtained in the saving of fuel, decrease in water consumption and the increased hauling capacity of the locomotives.

Right here at the beginning I wish to illustrate the points, of the fuel saving, and increased hauling capacity by an example which I think brings out the facts very clearly. From the results that have been obtained with superheaters in service it is conservative to say that the saving which has been effected in the fuel consumption under average

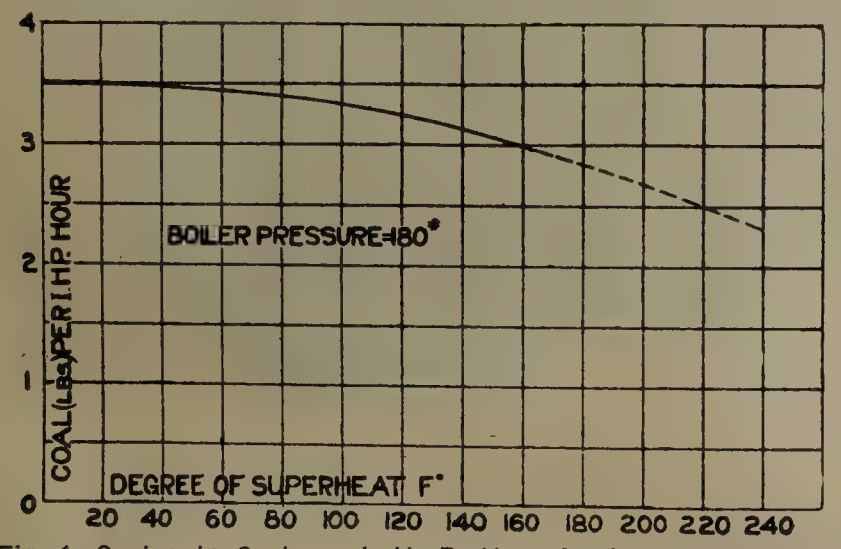


Fig. 1—Saving in Coal per I. H. P. Hour for Increasing Degrees of Superheat.

working conditions is 25 per cent. This saving is so large that we are liable to overlook the significance of the fact that this figure, 25 per cent saving in fuel, really means an increased hauling capacity of 33 1-3 per cent. Assume that we are burning in a saturated locomotive 6,000 lbs. of coal per hour and that this is the limit of the fireman's capacity. Assume also that the economy of our entire locomotive is such that we are able to get one horsepower hour with each four pounds of coal. Under these assumed conditions we are developing 1,500 horsepower hours per hour. Now suppose that we equip this same locomotive with a superheater, by the use of which we have been able to save 25 per cent in fuel, that is, our consumption is now three pounds of coal per horsepower hour, or 1,500 horsepower hours on 4,500 lbs. of coal. But the capacity of our fireman we assumed, to be 6,000 lbs. of coal per hour, so why not let him work up to his capacity? Thus in firing 6,000 lbs. of coal per hour with the superheater locomotive we are developing 2,000 horsepower hours, an increase of 500 horsepower hours, or 33 1-3 per cent. This increase of 33 1-3 per cent in horsepower hour means an equivalent increase in hauling capacity of 33 1-3 per cent, which is the real thing that is of importance to the railroad mechanical and operating departments inasmuch as it means a decrease in the investment in power and a corresponding decrease in the operating costs to handle the same amount of traffic.

The fire tube superheater by the use of which a temperature of the steam entering the cylinders of from 600 to 650 degrees or a superheat of from 200 to 250 degrees may be obtained, is almost universally adopted by railroads using superheated steam, because of the largely increased efficiency of the locomotive using such degree of superheat. At present there are something over 12,000 locomotives in all countries equipped with fire tube superheaters furnishing highly superheated steam. Over 2,000 of this number are in service in the United States. By high degrees of superheat is meant a superheat of from 200 to 250 degrees.

The principal advantages secured through the use of highly superheated steam are due to the increased volume of steam delivered per pound of water evaporated and the prevention of cylinder condensation. The economy which results from the use of the superheater is occasioned by the reduction of what is known as the "missing quantity" or the difference between the actual steam passing through the engine and that which is shown by the indicator card. This quantity is largely due to the loss by condensation in the passages to the cylinder and in the cylinder walls themselves.

Let us first consider the principal qualities of saturated steam. Saturated steam has the same temperature and pressure as the water from which it is evaporated and with which it is in contact in the locomotive boiler and for each pressure the steam has a certain constant temperature. At 170 lbs. boiler pressure for example, the steam will always have a temperature of 375 degrees F. and a volume of 2.47 cu. ft. per lb. If more heat is added to the boiler it is transmitted to the water and used in evaporating more water but does not increase the steam temperature as long as the pressure remains the same. If heat is taken away from the saturated steam in doing work or by cooling as in the steam passages of the cylinders, part of the steam condenses. The amount of the steam condensed is almost proportional to the heat abstracted and this condensed steam, or water, is inert so far as the capacity for further work is concerned.

The condensation takes place in the steam chests, cylinders and in the passages from the boiler to the steam chest. The greatest loss from condensation occurs in the cylinders, for here the variation in temperature is widest and the large areas offer a favorable condition for the loss of heat or for condensation to take place. The steam enters the cylinders practically at boiler pressure (disregarding the loss of condensation in the passages and the steam chest and other conditions which influence the pressure). Assume for example that the boiler pressure is 200 lbs. per sq. in. then the steam enters the cylinders at a temperature of practically 387 degrees F. It finds the cylinder walls in a comparatively cool condition. Immediately these cool walls begin to rob the steam of its heat and this continues throughout the stroke. The steam leaves the cylinder at a temperature corresponding to the pressure of exhaust, or about 230 to 240 degrees F. It also leaves the temperature of the cylinder walls about

*From a paper read before the Southern and Southwestern Railway Club, Atlanta, Ga., Jan. 18, 1912.

the same as the temperature of the exhaust, and the next admission of steam, which, by the way, enters the coolest end of the cylinder, finds the cylinder walls in this cool condition and must go through the same process as the preceding admission. Thus all the steam which enters the cylinders must go on giving up heat to the cylinder walls and thence to the atmosphere. The drop in temperature and the corresponding loss of heat of saturated steam means a corresponding amount of condensation and a proportional drop in pressure.

Tests show that, in Mallet compound engines without superheaters, the condensation in the receiver pipe runs up to over 20 per cent, while in simple saturated engines using short cut off, cylinder condensation runs up to over 35 per cent of the weight of steam admitted to the cylinders, that is, for every 100 lbs. of steam delivered to the cylinder only 65 lbs. are available for doing work. This loss, as stated above, can be overcome by the use of highly superheated steam, and means an average reduction of 35 per cent in the amount of water used and of 25 per cent in the amount of coal used per ton mile.

Let us now consider the principal qualities of superheated steam. When steam has left the boiler and passed into the superheater it is no longer in immediate contact with the water from which it was generated, if heat is now added to the steam. In its passage through the superheater tubes the moisture is evaporated and additional heat absorbed by the steam, so that on reaching the high pressure steam chest it has a temperature of about 200 degrees F. above that which it had when leaving the dry pipe. Meaning that it reached the high pressure steam chest at an actual temperature of about 600 degrees instead of 390 and 400 degrees, as is the case with a saturated engine. The pressure of the superheated steam, however, is practically the same as in the boiler.

Superheated steam partakes the nature of a perfect gas. It has a larger volume per unit of weight than saturated steam, and like a gas is a poor conductor of heat giving up its heat to the cylinder walls and steam pipes less rapidly. Taking superheated steam in the same proportions that were used in the case of saturated steam at 170 lbs. pressure with 200 degrees F. superheat it has a volume of 3.27 cu. ft. per lb. against 2.47 cu. ft. per lb. for saturated steam. Of course when superheated steam passes from the superheater to the comparatively cold cylinder walls some of its superheat is given up to these walls and the passages traversed in reaching the cylinders, but the condition differs from that of saturated steam in that it does not condense until it has lost all of its superheat and, therefore, the superheater must be so designed that under all working conditions it furnishes more superheat than the steam can lose in the cylinders.

The curve shown in Fig. 1 shows the saving which is effected in the pounds of coal per indicated horsepower hour for various degrees of superheat. It also shows that the saving is very small for low degrees of superheat and increases more rapidly for higher degrees of superheat. Referring to the curve it will be noted that from 0 to 160 degrees of superheat a saving of one-half pound of coal per indicated horsepower hour was effected while this same saving was again effected in the next 60 degrees of superheat. Reference is made to this subject in the report from which the curve was taken as follows:* "The coal consumption per indicated horsepower hour at 180 lbs. steam pressure for the locomotive using saturated steam was 3.50 lbs., and for 80 degrees of superheat was 3.40, a gain in efficiency of 2.8

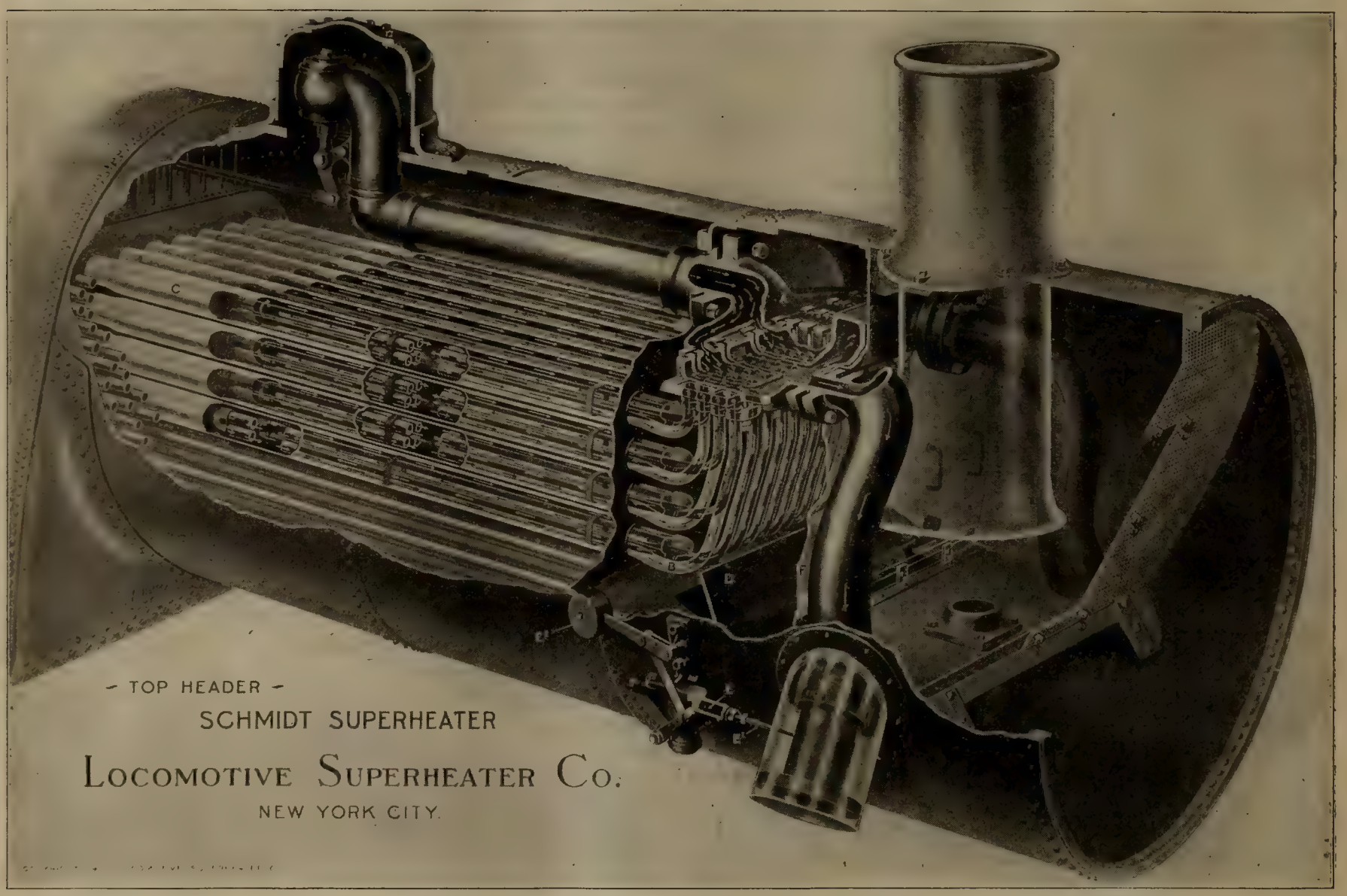


Fig. 2—Top Header Fire Tube Superheater Assembled.

*Taken from a paper entitled "Locomotive Performance Under Different Degrees of Superheat," read before the A. R. M. M. A., 1910, by Prof. Benjamin and Prof. Endslay.

per cent, while the consumption at 160 degrees superheat is 3.00 lbs., a gain of 14.8 per cent, which is five times the saving of the first 80 degrees. Now, if this line indicating a steam pressure of 180 lbs. is carried as a smooth curve to 240 degrees superheat, as shown, it would indicate a coal consumption of 2.35 lbs., or a saving over the saturated engine of 32.8 per cent.

The effect of the superheater on the boiler is to increase the boiler capacity in proportion to the decrease in the demands that are made on it from 25 to 35 per cent. It has been shown that as the demand for power is increased the degree of superheat increases so that the demand on the boiler does not increase in proportion. It is therefore economical to force a superheater engine, while it is not economical to force a saturated boiler in the same way, and it is many times impossible to do so for any length of time. The fact has been proven that locomotives equipped with superheater developing high degrees of superheat, have at least 25 per cent greater boiler capacity than the same size of engine without a superheater. As the engine is worked harder, the fire is forced, which means a higher firebox temperature and hotter gases in the superheater. This results in a higher temperature of the steam, and with this higher superheat we begin to get the greater efficiencies which are characteristic of the superheater steam locomotives when they are worked hard. The fact explains the variation in fuel saving obtained by different superheater locomotives and emphasizes the fact that the greater economies are obtained when the engine is being worked the hardest.

In engines operating in poor water districts where foamy water and fluctuations in water level would tend to increase the amount of water carried over from the boiler, it can readily be seen that a device which reduces the demand on the boiler, and which still, in addition, prevents the water from reaching the steam chest and cylinders, will greatly lengthen the life of the valves and pistons, prevent breakage of cylinder heads from water pressure and also lengthen the life of the boiler. Another feature which favors the boiler in the use of superheated steam is the comparatively low boiler pressure which may be carried, as the size of the cylinders is not limited, as in the saturated steam engines where the diameter of cylinder must be limited in order to reduce condensation.

Standard recommendation for boiler pressures to be used in connection with superheaters are 180 lbs. for freight engines and 200 lbs. for passenger engines. In bad water districts even lower boiler pressures may be used with correspondingly enlarged cylinders.

The use of the brick arch in connection with the superheater favors higher degrees of superheat. The arch acting as a baffle wall produces a longer flame way, of giving the gases a greater time to mix with the oxygen and thereby complete the combustion resulting in higher temperature in the firebox and the flues. It also has a tendency to direct the hotter gases through the larger flues which are located in the top part of the boiler.

From the foregoing existing conditions which the superheater is designed to meet, the requirements for an efficient and practicable fire tube superheater may be summed up as follows: An integral header which is out of the way, in no way obstructing the front end or interfering with the maintenance of the boiler tubes so designed as to cause the least tendency toward wire drawing of the steam; the arrangement of superheater pipes which are easily accessible and removable and so constructed that the unequal expansion caused by the difference in temperature as the steam passes through the tubes will be taken care of; and superheater flues located in the upper part of the boiler where the tendency toward clogging is least and the temperature is highest. These points have been carefully provided for in a superheater which is shown in the accompanying illustrations.

The superheater assembled, Fig. 2, consists of a header "A" supported on brackets in the smoke box and making a joint with the steam pipe in the same manner as the Tee head, or what is commonly called the "Nigger Head," used in the saturated engines. Attached to the header and in communication with it are the coils or units "B" made up of cold drawn seamless steel tubing and screwed into return bends. Each unit is located inside a large flue "C" and extends to within about 2 ft. of the back flue sheet. The larger boiler flues are set into the front and back flue sheets in very much the same manner as the ordinary small boiler tubes.

The tools which have been found to give satisfactory results in setting the large flues are a flue roller, consisting of five rollers, and a prosser or expander made up of twelve sections. The recommended operation of setting the flues employs a copper ferrule in the fire box end; the rolling, prossering and beading of the flue in the firebox end, and the rolling and beading of the flue in the front end. In the introduction of the copper ferrule it is advisable to break the corner of the hole in the tube sheet on the outside of the sheet in order to remove any burr that may be left by the cutting tool, and also to remove the tendency of the sharp corner cutting into the flue. In beading the flues the beads should be carefully turned down against the sheet. In the maintenance of the flues, the prosser should be given preference.

The flow of gases through these tubes is controlled by a damper "D" which is operated by the damper cylinders "E" located at the outside of the smoke box. The normal position of the damper is open when the engine throttle is open, thus allowing the gases to pass through large tubes and come in contact with the superheater units.

The deflecting plate "F" is in a vertical position and this in connection with the horizontal partition which extends from the deflecting plate to the front flue sheet and contains the damper, makes the complete enclosure for the header and the part of the superheater units which extend through the front flue sheet into the smoke box. The deflecting plate is made in parts to be easily removable. The operation of the superheater is as follows: "First when the throttle valve is open saturated steam passes through the dry pipe and into a portion of the superheater header designed to receive the saturated steam. From this portion of the header which is in communication with one end of the superheater units the steam passes downward through one tube of the unit, backward toward the back flue sheet, forward and backward again and then forward and upward to the other side of the header designed to receive the superheater steam. From the header it then passes into the steam pipes, then into the steam chest and into the cylinders. This is the course of the steam through the superheater. The course of the gases through the large tubes is as follows: The position of the damper when the engine is not working steam is closed. At the opening of the throttle valve steam is admitted to the damper cylinder "E" through pipe E1, which is in direct communication with the steam pipe and damper cylinder. This automatically opens the damper by means of a bell crank connection between the damper piston rod and the damper shaft. Simultaneously with the opening of the damper the counterweight E2 is raised to the position shown in the illustration from which position it will fall when the steam is shut off and the damper will again be closed. The opening of the damper provides for the flow of heated gases from the firebox through the large flues. The reason for the introduction of the damper system is to protect the superheater tubes against overheating while no steam is flowing through them to absorb the heat.

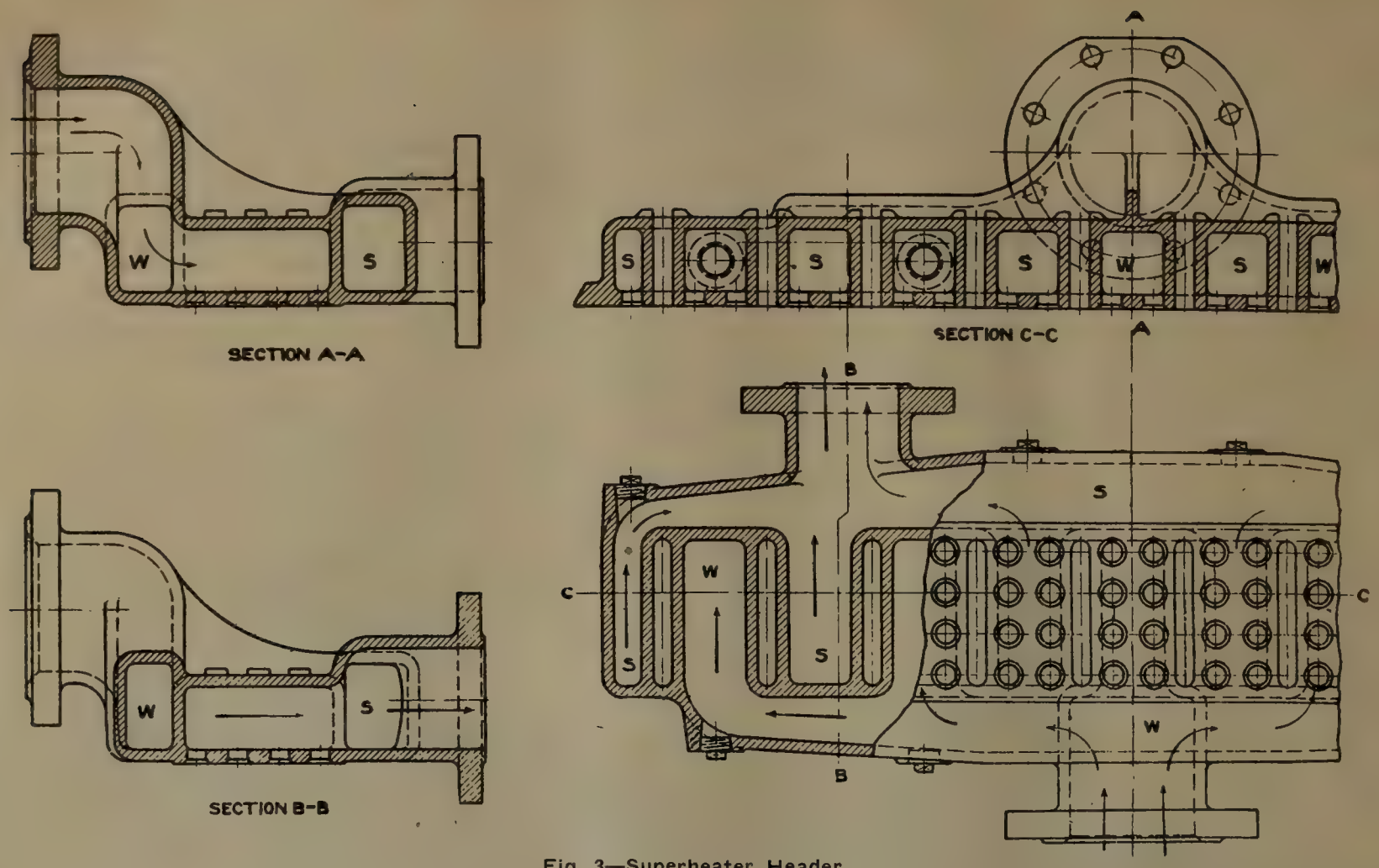


Fig. 3—Superheater Header.

Fig. 3 shows a detailed view of the header casting through several sections. Section through AA shows a section of the steam pipe connection of the header and the passage way and also the back and front end passage for the saturated and superheated steam. The passage way marked S represents the superheated and that designed W, the saturated steam passage way which are in communication with the respective chambers marked S and W, in the section to CC. The units, which will be shown in the next illustration, are held in place by a bolt which extends through slots in the header casting between the superheated steam and saturated steam chambers and are prevented from turning by bosses or lugs located at the top facing of the header. The section through BB shows a section of one of the top steam pipe connection and is similar in other respects to section AA. In the plan view of the lower side of the casting is also shown a part cut away to indicate the arrangement of the saturated and superheated steam chambers and the direction of the flow of the steam through their passages.

The superheater unit and the ball joint connection together with the clamps for holding the joints in place in the header are shown in Fig. 4. The ball connection of the units of the tubes each ground to fit the seats in the header casting and clamped to the header. This clamp is supplemented by a ball ring fitting under the ball of the tube in the manner that will provide for any irregularity that may occur in the ball heads or in the depth of the seat in the header. The return bends are of cast steel and are provided with lugs which rest against the inside of the large flues and keep the superheater units in the upper part of each flue.

The superheater tubes it will be noted may be easily removed and replaced, and in doing this it is not necessary to take down the steam pipes. It is also possible to thoroughly inspect the front end, and do all necessary work on the boiler flues, boiler tubes and the front tube sheet seam, without the necessity of taking down the superheater header or the steam pipes. A hand hole opening is usually provided on the smoke box sides through which inspection may be

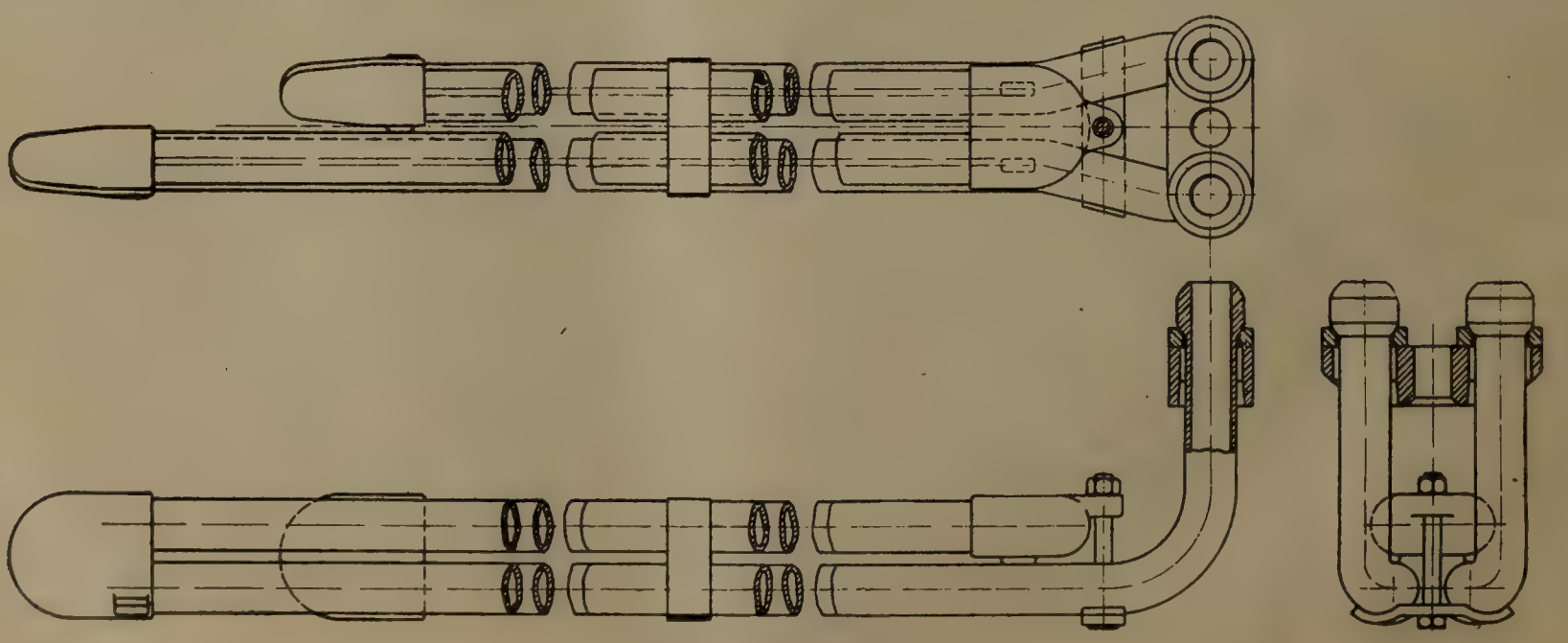


Fig. 4—Superheater Unit.

made of the entire front end of the superheater by the aid of a light, without taking down the front end netting or even opening the smoke box door.

Fig. 5 shows the front end arrangement of the superheater applied in connection with the outside steam pipes. It clearly shows the convenience of the outside steam pipes arrangement, which are being applied quite generally to locomotives equipped with superheater in this country. This arrangement provides the two lower steam pipe joints outside the smoke box making it easy matter to locate leaks in these joints, should any such occur, and when these leaks do occur they do not effect the steaming quality of the engine as in the case of steam pipe joints located inside the smoke box. A small leak in this joint located inside the front end will destroy the draft and interfere greatly with the steaming qualities of the engine. Another advantage in their use is the absence of stress and heat interchanges in the cylinder saddle caused by the difference in temperature of the live steam and exhaust steam on opposite sides of the same wall. Outside steam pipes also offer a greater clearance in the lower part of the smoke box affording the better opportunity for drafting the engine and making the operation of cleaning the front end very much simpler.

The introduction of the outside steam pipes greatly simplifies the construction of the cylinder casting. It eliminates the steam passageway in the saddle leaving only the exhaust passage. It also reduces the weight of the cylinder casting and simplifies the coring.

After this description of the superheater and the front end arrangement of a superheater locomotive very little need to be said about the requirements regarding the other engine details coming in contact with superheated steam. The joint rings between steam pipes and header and steam pipes and cylinder should be made of cast iron; brass ring would not stand the high temperature on account of desintegration. Piston valve rings and piston rings and bushing should be close grained cast iron and not too much attention can be given to the quality of material of these parts. The ordinary designs of piston rod packing rings should have a higher melting point than usual in saturated engines. An alloy of 80 per cent lead and 20 per cent antimony has given satisfaction. A very essential requirement in connection with the superheater locomotive is the use of good oil, and continuous lubrication. The system found to be best adaptable for a simple two cylinder engine is a five-feed lubricator, the leads to be into the steam pipes or the center of the steam chests and into the center of the cylinder. The fifth feed to lead into the air pump steam pipe in the ordinary

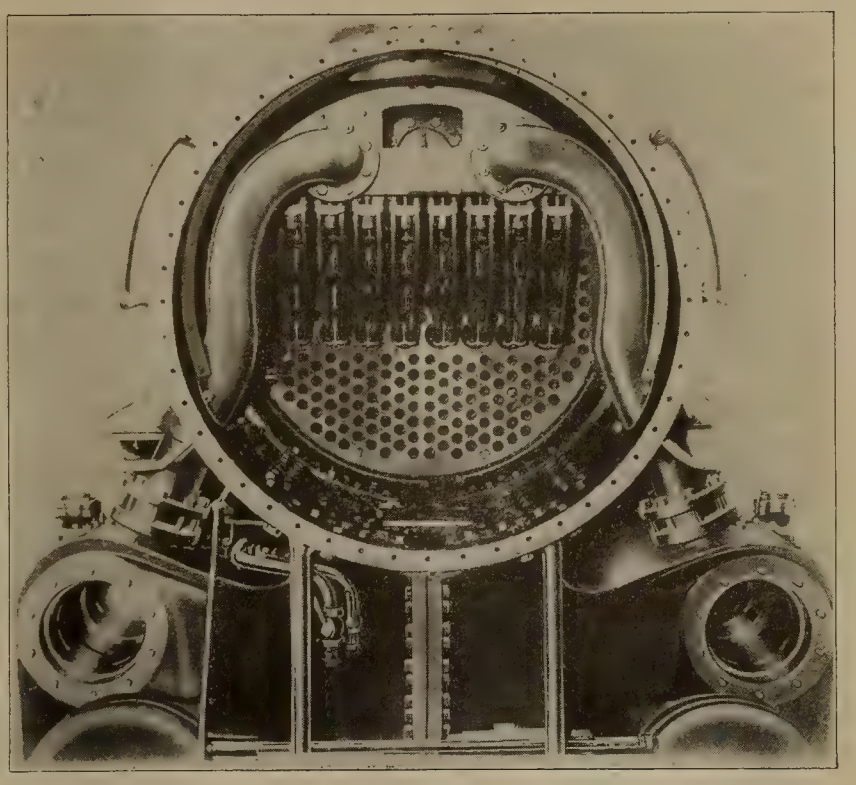


Fig. 5—Superheater Applied in Connection with Outside Steam Pipes.

manner. The feeds to the steam chest should enter the center of the steam chest and should not be branched off. The steam chest should get three or four drops of oil for each drop fed to the cylinder. Vacuum valves of ample size on each steam chest are more essential in a superheater engine than in ordinary engines on account of the higher temperature of the steam chest cylinders. While the engine is working steam, the oil is sufficiently protected by the steam against carbonizing. While drifting, however, the oil has no such protection and on account of the high temperature of the steam chest walls would have a tendency to carbonize, which can be overcome by vacuum valve, letting cold air in.

The piston rod extension has also been found to be of considerable value in reducing the wear of cylinder bushings and cylinder packing rings. The extended rod riding on guides relieves the cylinder bushings and rings from the weight of the piston, and thereby, reduces the friction and the wear upon them. The design of the extended piston rod which is illustrated in Figure 6 has been applied to a larger number of superheater engines during the last twelve months with satisfactory results. This design was brought forth by F. J. Cole, chief consulting engineer of the American Locomotive Co. The history of the extended piston rods is marked

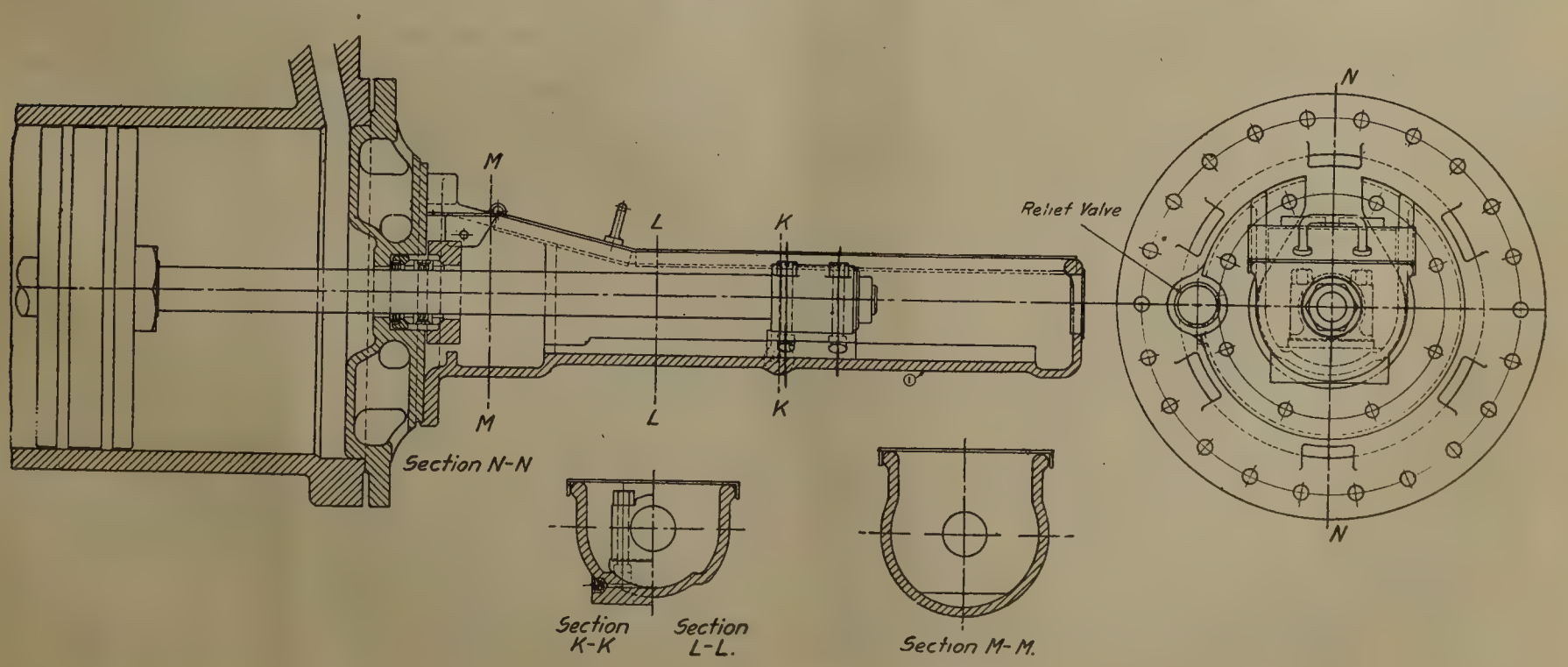


Fig. 6—Piston Rod Extension and Guide.

by a large number of designs which have not been successful. A piston rod extension to be satisfactory must be of simple yet rigid construction; easy to lubricate and easily removed without interfering with other parts of the locomotive, and above all it must have an ample bearing surface, a feature which was lacking in all of the earlier designs of piston rod extensions.

It will be seen from the illustration, the principle of the present style of extended rod guide is that of a miniature crosshead at the front end of the extended rod and this slides on a cylindrical surface, which is rigidly supported and easily located on the cylinder head. The design permits of maintenance being easily and quickly made by lining up between the small crosshead shoe and its body. The packing on the extended rod is easy to access and attended to without difficulty.

The guide for this small crosshead is self-centered on the circular flange of the cylinder head and thereby required no adjustment in service, as it cannot get out of position.

A feature of this design of extended piston rod is that the guide is made with an open top so that when it is necessary to remove the same it can be dropped from the rod and does not require a large amount of space ahead of the cylinder.

The superheater can be successfully applied to any of the existing types of locomotives provided these locomotives are equipped with piston valves. By this application the boiler capacity will be increased 25 per cent, that is, the old engine supplied with a superheater will be capable of doing 25 per cent more work. It will be possible to haul correspondingly heavier trains on the same schedule, or the same trains on a proportionally faster schedule. It has been found in many cases that trains double headed with saturated engines could be handled with one superheater engine. The boiler maintenance is also reduced in that it is possible to reduce the boiler pressure if the construction of the cylinders is such that their diameter may be increased. By increasing the size of the cylinders without decreasing the boiler pressure the engine is given a greater starting power and the increased boiler capacity will more than take care of the demands of the larger cylinders for steam.

In summing up briefly the advantages of highly superheated steam in locomotive operation, we have directly a saving in fuel of about 25 per cent, and a saving in water consumption of 35 per cent and by the utilization of this economy, indirectly a saving of 33 1-3 per cent or an increased hauling capacity of 33 1-3 per cent.

A TIMID DAREDEVIL.

Recently B. F. Bush, president of the Missouri Pacific Railway System, and Governor Hadley of Missouri, made an automobile trip through the state in the interest of the goods roads movement. Barney Oldfield drove the car, and he performed his duties with his usual ability, even to making a speech where he couldn't get out of it.

When on the return trip it was found necessary to take a train from St. Joseph to St. Louis for a hurried run in order to meet some engagements, the party boarded President Bush's private car and the engineer was told to let her out. The special train was making about 65 miles an hour along the winding banks of the Missouri river, hitting curves banked for only 55 miles, when it was noticed that Oldfield was getting nervous. He kept constantly jumping up and peering out of the windows. The river did not look good to him. Nothing looked good to him. Finally, unable to stand it any longer, this man, who nonchalantly drives a car 100 miles an hour, admitted his fright by shouting above the noise of the train, "Slow her up; slow her up. Do you think this is an automobile?"—Wall Street Journal.

WHAT SHALL WE DO WITH THE TRUSTS?

By J. P. Colby, Public Accountant, Boston, Mass.

Just now everybody is talking about the trusts. All the spell-binders and the writers and the bankers and the statesmen, and even the politicians, are taking a hack at the much-mooted question, "What shall we do with the trusts?"

In the days before the advent of air brakes, there was once an engineer who knew how to run his engine perfectly well, taking fifteen carloads of passengers, a hundred children in every car, 1,500 persons in all, to the annual picnic. The train struck a down grade and the heavy load of precious human freight was more than the engine could hold back, when suddenly far down the track appeared a little girl playing. The engineer reversed his engine, tooted down brakes, called out the brakemen, but all to no purpose—the momentum was too great and the train rapidly approached the little child, innocent of any danger, playing on the track. Relating the circumstance himself, the engineer later said: "Well, boys, I don' 'no why I dun it, but I dun it; jest before the train reached that girl I had a chance to ditch 'er and I ditched 'er—an' I saved the life of the little girl, but I killed 400 passengers. I got fired, of course, but what cu'd I do? Had to do something."

The government is trying to do something, just now, to save a situation and also to prove that the Sherman law is a good law—"reasonable" law, as it is interpreted and applied, upon occasion, by the government.

What is the situation, anyway? How came it about? Who is responsible for it? Who is its father and its mother? Who is there who will now step forward and say that he or his co-politicians were responsible for either the Sherman law or the situation now forced upon the country by the government? Let us think a moment.

If memory serves, back in the term of McKinley the diplomatic, who was succeeded by Roosevelt, the fighter, who was succeeded by Roosevelt, the honest endeavorer, who was succeeded by William H. Taft, a smiling gentleman trying to wear the coat made by Roosevelt—back, as we said, to the time of McKinley, must we turn to trace the lineage of the trusts, all the while not only fostered and guarded but encouraged under the Sherman law—all the while up to the near-end of the reign of Roosevelt.

Just what happened then it is difficult to remember. Some said the trusts were not playing fair. Some said that Charles W. Morse with his little hatchet cut down too many young financial cherry trees and—wouldn't stop; and others gave other reasons for the beginning of the revulsion of feeling against the corporations and the trusts. As near as can be judged, however, early in 1907 some one in the department "of justice" at Washington, time hanging heavily on his hands, re-read the Sherman law, or, reading it for the first time, in its entirety, suddenly paused and said, "Well, strange I never noticed that before; here we have built up the trusts under this law until they say they are too big, and right here is a clause whereby we can put 'em out of business under the same law. We can get 'em coming and going, sure as preaching." And just as sure as preaching the government, after getting them to coming, started in right there to get them agoing.

It would be very interesting to know precisely what Theodore Roosevelt said to William H. Taft about the trusts when he handed him his club and toga. Seems as if Taft didn't quite understand what was meant for him to do. Roosevelt has spoken up of late and said that he would not do it quite the way Taft is doing is—doing the trusts—and this we believe.

But it is a very serious question—the one question of greatest importance, industrially speaking, that has ever been

asked the voter, who also is the worker and the investor, "What shall we do with the trusts?"

An intelligent and fairly accurate attempt to answer this question involves too much to be considered properly in one article. It involves consideration of such subjects, all pertinent, as: "the natural trend of all properly conducted business"; scientific management; of "elimination of waste, which is the mainspring of scientific management"; of "disintegration"; of "reorganization"; of "corporation registration under the government"; of "government charters for all newly formed corporations"; of "government regulation and control"; and directly or indirectly of "government ownership" or control of the corporations it charters, or may later create. A full discussion also involves the question of proper and just treatment of labor by capital; the elimination of waste from the ranks of labor for its own benefit, and its reorganization, capitalization and centralization, also for its own benefit, under proper and uniform state laws or under a general federal law, to the end that labor will make its leaders amenable to law and that it may receive a fair and just return for its efforts; and the question of what we must do with the trusts also involves that psychological question of the unreliability and the meanness of human nature under prosperous conditions. Is it any wonder, then, that President Taft is trying to do something? There is much to be done—and election is coming next fall.

An experience of over twenty years in figuring for the general public, mainly for the corporations, always for capital either running smoothly or in the throes of trouble, always with the question before me, "How can we earn more money on our capital?"—always handling this question scientifically with the use of the detective "percentage" to indicate how the expense accounts may be cut down, has led, unconsciously, to a somewhat careful consideration of this mighty question which has so suddenly arisen, like some monster awakened from a long and troubled sleep to the din of the stone-age men planning to destroy it. And, strange to say, the government has gotten right down to first principles in its methods of warfare against the trusts, and some of its methods are like those of the stone-age men killing off an ugly old dynosaurus; just bang him over the head until he is unconscious, then bring him to and turn him loose in another pen, no matter how many of our "yung-uns" we may kill doing it. "Just hit 'im!"

Briefly, I will touch on some of these subjects as I have observed them and believe they must be handled.

The natural trend of all business, properly, prudently and wisely managed, is towards consolidation, concentration and the elimination of waste. The very spirit of business requires it and the exigencies of business demand it. Water does not run up hill unless forced up hill, nor does it stand still without becoming stagnant. Hence, all business must, if it succeeds, progress and proceed along the lines above indicated. It is the unwritten law of the nature of business that it will proceed along lines of least resistance most quickly, but also that it will move along lines of greatest resistance when profits invite it; not because of resistance, but in spite of it. Hence, then, combinations must and will follow. Corporations and combinations, obeying fundamental business laws, have become naturally and properly the order of the day, and then came the trust, born of the corporations.

Always, into every successful business, has arisen the question of how to eliminate waste: if not all of it, then how much of it? In the formation and in the conduct of the corporation there has not yet, apparently, been considered that most important question of all questions, "How can be eliminated that most wasteful thing on earth"—that individual who, when considering how he could organize a corporation to father and exploit his ideas or his struggling business, that person who, carefully, and oftentimes with borrowed pencil, first of all determines precisely what will be 51 per cent of the capital stock in his new corporation, and who, when he gets his charter, or often before he gets it, has stock certificates printed and causes to be issued to himself 51 per cent of the capital of the corporation, which he places in his vest pocket, and then proceeds to sell 49 per cent to the honest investor to obtain capital enough to conduct the business. Too often has it also been true that when the stock sold well, the legitimate purposes of the corporation have been abandoned for the illegitimate purpose of only selling stock for which large commissions are paid and large salaries are received—by whom? Why, the holder of the 51 per cent, of course. Is there any shame in this situation? No, not a particle, as these matters are regarded today. The only question of vital importance in hundreds, yea, in tens of thousands of corporations, the only question seriously considered is, "How can we get by?"

The trusts have absorbed the corporations. They are said to "operate in restraint of trade." That is, they want and scheme to get and to control all the trade there is, all the output of their particular line of industry. Corporations, we are told, have no souls. Having no soul, the trust is unable to discriminate between the desire for more than it needs and the just requirements of their chiefest, and, in the end, their only asset, the worker, for money, sometimes, is a poor asset. It all depends upon how it is gotten. "A good name is rather to be chosen than great riches."

Not being able to control its desire for more money, which it does not need, not being able, having no time, to recognize or to heed the just demands of labor, how, we may ask, in what manner, may the trust be compelled to do the square thing—how can it be compelled to divide properly with labor? Here they are, all organized, doing business at a "lickerty-split" rate, piling up under scientific management more and more profits in the vest pocket of the owner of the 51 per cent.

The 49 per cent men get mighty little, in comparison to what the 51 per cent man has gotten, first and last. But what the 49 per cent man has, he has paid for, he owns it, and his investment, honestly made in hard-earned dollars, is a sacred thing to him.

Along comes a statesman-politician and says, "Well, we'll smash the trusts. We'll show 'em just what we can do, and we will do it," and they proceed to do it. Who is now really hurt in this process of trust-busting? Probably the 51 per cent man has sold his holdings and the entire capitalization is now owned by the innocent investor who has placed therein his hard-earned dollars. Uncle Sam continues to "bust the trusts." The 51 per cent man, his money all in his pocket, sits tight, smilingly waiting until all the component parts have been scattered, waits until the omelet is thoroughly unscrambled, and then coolly buys back at a low price the offerings of the frightened investor who once placed his hard-earned dollars in the proposition. Who, in the name of sweet Heaven, has been benefited by this operation but the 51 per cent man? This trust-smashing of the government is more cruel than the cruelty any feudal over-lord ever practiced on his dependent vassals.

The government, if it must do something, and it must, might properly supplement the Sherman law and, with a commission, should compel every corporation now in existence to step up with its balance sheet and have its assets and its liabilities examined and carefully recorded, with special reference to the exploits of the 51 per cent man, and how he converted his 51 per cent into dollars. This should be compulsory.

The government should pass a national incorporation act compelling all new corporations to take a government charter, which should be granted only after it has examined the assets of the proposed corporation and has proven that every

dollar of its fair equivalent is invested in amount equalizing, at least, the capitalization to be issued or the total liabilities.

The government has already taken a long step in the right direction by passing the federal act of August 5, 1909, taxing the income of all corporations earning in excess of $5,000 net, in profits, and compelling sworn statements to be made annually by corporation officials. These sworn returns should also be made public records, available to the public just as a mortgage on realty is made a public record.

The government should say to labor, go and incorporate under proper state laws or under proper federal laws so that your organizations and your officers may be amenable to the laws of the land just as are the officers and property of business corporations.

Having, now, the corporations or trusts controlled by the government by charter, by inspection and by direction, let the government say to the laborer, "You must take one share, at least, in the stock of the corporation you work for. If you cannot pay for it at once, then you must pay for it in weekly installments. But a partner, a co-operator, a co-profit-sharer you must become, in the particular business in which you earn your living and in which you ought to have a direct interest." "But," says the 51 per cent man, "I won't invest my money in any such enterprise."

And suppose Uncle Sam should say to him, "Oh, very well, I am looking after this business, I know what it will earn, what it owns, how its property is invested and what it is worth, and I will loan on its bonds to the extent of 50 or 60 per cent of its capitalization." Who, then, may we ask, holds "the butt end of the stick?" Who, then, are the owners of the equity in that business and how are they protected? Think it over.

Scientific management must go on until there has been eliminated the 51 per cent man and the professional politician from the financial body politic. More honey-gatherers are needed—a smaller number of drones are desired.

Capital needs only a fair return on its investment; but, more than all, it needs protection from unwarranted attacks not only from within a corporate form it may be working under but without that form, whether the attack comes from the government or from labor.

Labor must eliminate the false prophet, the false leader and the grafter from its ranks, and it has already set itself about doing so. Labor needs an honest business manager, able at least to determine how much it has contributed of its vitality and its energy in exchange for a slight increase of wages, under the scientific management of the trusts; and such a manager as can compel a fair division of the extra profits under scientific management, which labor has never yet received, if the illuminating articles on "The Gospel of Efficiency" and scientific management are correct statements. Being made by a representative of the trusts, they must be assumed to be correct, as far as they go into details.

The "common people" need—yea, are about to receive—fair and proper treatment, and within the term common people are included all the honest workers and investors.

The grafter, whether he graft on labor, the municipality or the commonwealth—and the tax-dodger is one of them—must go. Only in foreign countries do they know how to handle graft—their way. There they lift the grafter up, place him on a throne, crown him, and then, he being of divine origin, they bow down and worship him. In this country we are eliminating waste as a correct and scientific business principle, hence we are pursuing the grafter, and we will get him yet.

Right now the question looms up, "Who is that man who, having received the nomination for the presidency, can most wisely, firmly and tenaciously deal with questions herein briefly touched upon?" They are all vital, they all affect the masses, and they must be settled or regulated soon. And they will be dealt with to the advantage of the masses, directly.

Very soon things will begin to loosen up, "politicianally" speaking. There are signs of an early spring in politics. Just now, however, everything is as calm and serene as a "peace society banquet"—with the genuine peacemaker absent.

RAILWAY STOREKEEPERS' ASSOCIATION.

It has been decided by the executive committee to hold the ninth annual meeting of the Railway Storekeepers' Association on May 20-21-22, 1912, at Buffalo, N. Y. Following is a list of committees:

Recommended Practices.

One Year—H. C. Pearce, Southern Pacific Co., San Francisco, Cal.; H. C. Stevens, Nat. Rys. of Mexico, San Luis Potosi, Mex.; T. W. Flannagan, M. St. P. & S. S. M., Minneapolis, Minn. Two Years—C. C. Dibble, L. S. & M. S. Ry., Collinwood, O.; E. J. McVeigh, Grand Trunk Ry., Ottawa, Ont.; J. W. Foyle, M. K. & T. R. R., Parsons, Kas. Three Years—J. H. Waterman, C. B. & Q. R. R., Galesburg, Ill.; Geo. Holmes, Michigan Central R. R., Detroit, Mich.; W. L. Cooper, M. & O. R. R. Murphysboro, Ill.

Piece Work.

D. C. Curtis, C. B. & Q. R. R., Chicago, Ill.; B. W. Griffith, L. S. & M. S. Ry., Collinwood, O.; J. W. Gerber, Southern Ry., Washington, D. C.

Scrap Classification.

D. Kavanagh, Rock Island Lines, Silvis, Ill.; E. J. Roth, C. B. & Q. R. R. Chicago, Ill.; W. F. Girten, Scranton, Pa.; C. C. Dibble, L. S. & M. S. Ry., Collinwood, O.; H. A. Anderson, Penna. R. R., Philadelphia, Pa.

Accounting.

D. A. Williams, B. & O. R. R., Baltimore, Md.; E. L. Fries, Harriman Lines, Chicago, Ill.; E. E. McCracken, B. & L. E. R. R., Greenville, Pa.; F. R. Brown, C. B. & Q. R. R. Aurora, Ill.; W. H. Grassman, N. Y. C. & H. R. R. R., W. Albany, N. Y.

Uniform Grading and Inspection of Lumber.

J. H. Waterman, C. B. & Q. R. R., Galesburg, Ill.; J. R. Mulroy, St. L. & S. F. R. R., Springfield, Mo.; W. F. Jones, N. Y. C. & H. R. R. R., New York, N. Y.; N. M. Rice, A. T. & S. F. System, Topeka, Kas.

Standard Grain Door.

D. Kavanagh, Rock Island Lines, Silvis, Ill.; E. J. Roth, C. B. & Q. R. R., Chicago, Ill.; W. A. Summerhays, Ill. Central, Chicago, Ill.

Membership.

N. M. Rice, A. T. & S. F. System, Topeka, Kas.; E. E. McCracken, Assistant, B. & L. E. R. R., Greenville, Pa.; J. H. Callaghan, Canadian Pacific Ry., Montreal, Can.; H. S. Burr, Erie R. R., New York, N. Y.

Stationery.

H. E. Rouse, Chicago Gt. Western, Oelwein, Ia.; E. E. Herold, D. & O. R. R., Baltimore, Md.; N. A. Waldron, St. L. & S. W., Pine Bluff, Ark.

Standardization of Tinware.

J. R. Mulroy. St. L. & S. F. R. R., Springfield, Mo.; H. C. Pearce, Southern Pacific Co., San Francisco, Cal.; J. H. Waterman, C. B. & Q. R. R., Galesburg, Ill.; F. D. Reed, C. R. I. & P. R. R., Chicago, Ill.; H. A. Anderson, Penna. R. R., Philadelphia, Pa.; W. F. Jones, N. Y. C. & H. R. R. R., New York, N. Y.

CONSIDERABLY LESS THAN NOTHING.

Topeka, Kan.—A new means of providing electricity—a composition that costs *several hundred per cent less than the present system*, is startling the officers of the Santa Fe Railroad in Topeka. The invention has been under consideration in the office of C. W. Kouns, general manager, and L. M. Jones, superintendent of telegraph, for some time.—*Railway Record.*

STEEL CARS IN COLLISION.

The accompanying photographic reproductions shown herewith are printed, not with the idea of condemning any particular form of construction, but because it is believed that a study of the effects of this, one of the more serious accidents since the commencement of the use of the steel passenger car in American railway operation, is of real educational value to those interested.

It is possible to speculate and draw conclusions as to what might have happened had these cars been of wooden construction. Opinions vary as to whether the results would have been more or less serious or practically the same. The stiffness of the underframes is called particularly to the attention of the reader.

It will be noted, that the accident was a rear-end collision, a steel sleeper being telescoped with a diner next ahead of it. Other circumstances with respect to the accident are immaterial to the object of this article. The photographs are bona fide and are published by courtesy of Popular Mechanics Magazine.

The cast steel bolster and platform at the rear end of the sleeper were broken and split apart as far as the center plate. This must have tended to raise the rear of the sleeper and depress the forward end, so that the pressure of the collision tended to raise the dining car underframe above that of the sleeper, producing a telescopic effect which is shown in one of the photographs, showing how the six-wheel trucks were driven together and how the dining car entered the sleeper for one-third of its length.

The two underframes in this portion of the collision sliding past each other, were not very badly damaged, and the platform casting, the steel bolster and the center sills at the front end of the sleeper were almost intact, those of the dining car being in the same condition. The roof of one-third of the

sleeping car was thrown clear up on top of the dining car and the sides of the sleeper split and spread apart, as shown clearly in the illustration.

Many suggestions have come from those who have made inspections of the wrecked equipment. It has been pointed out that the very strong construction of the underframes caused the upper parts of the cars to suffer more severely than would otherwise have been the case. The condition of the roof shows a necessity for stronger construction at this point to make the resistance of its end plates more nearly proportional to that of the end sill.

Inspection of the photographs cannot but bear out the statements of those who have long argued that the cost of repairs for steel equipment is considerably greater than is the case with that built of wood. The siding, side sills and interior finish are so nearly destroyed that repairs are made almost impossible.

EXPLOSIVES.

It has come to the attention of the Bureau of Explosives, American Railway Association, that many of the users of explosives and especially miners who are foreigners not conversant with the English language or the requirements of the federal law, are in the habit of including packages of explosives in their baggage checked in the usual way on a passenger train and in packages of household furniture shipped in the usual way by freight.

The federal law strictly forbids a concealed shipment of explosives or the transportation of explosives on passenger trains even when declared. Packages of explosives must be packed in their regular shipping containers properly marked and accompanied by shipping orders of the usual form. The penalty provided for violations of the federal law are severe and may equal a fine not to exceed $2,000, with or without imprisonment not to exceed 16 months.

Many violations of the kind described above have been reported and in all such cases where the evidence was sufficient to warrant conviction prosecutions have been started. Guilty parties even when their action was due to ignorance have been fined and imprisoned; ignorance is no excuse for a violation of this kind.

As examples, it may be stated that miners and other parties have taken kegs of blasting powder and even packages of loose sticks of dynamite mixed with blasting caps all wrapped in loose paper packages into the smoking cars of passenger trains. In other cases wash tubs and barrels supposed to contain only household goods have been found to contain loose powder and sticks of dynamite.

PROTECTIVE DEVICES.

By the installation of protective devices, the Pennsylvania Railroad is said to have decreased the number of serious injuries to employes in its shops by more than 63 per cent from January 1st to November 1st of last year. In recognition of this work the American Museum of Safety will present a medal to that company as the American employer who, in its judgment, "has done the most for the protection of the lives and limbs of his workmen, by means of safety devices for dangerous machines and processes."

In the fall of 1910 experts from one of the large accident insurance companies were employed and, accompanied by inspectors of the motive power department, inspected all of the larger shops. Following this, safety committees were organized on all divisions of the road. As a result, the number of serious injuries per one thousand shop employes was, in January 8.7, February 7.3, March 8.3, April 6.0, May 7.9, June 5.2, July 4.7, August 3.4, September 3.4, October 3.2. During this period, the average number of employes was 33,242.

THE ACCOUNTING DEPARTMENT IN CONNECTION WITH THE MECHANICAL AND STORES DEPARTMENT.*

By A. A. Goodchild.

The function of accounting and auditing is the accumulation and statement of facts or conditions, by means of which the proprietors and managers may know the financial and operating features of a corporation, or of any portion of its business, and it is generally recognized that the head of the department in charge thereof must have a very complete knowledge of the workings of every other department as well as his own, owing to the fact that all of them, whether revenue producing or otherwise, will be found to come under his surveillance in some manner or another.

The method by which this surveillance is exercised, however, varies considerably in the many railroads of this continent, and in no case is it more noticeable than in connection with the mechanical and storekeeping departments, to which our attention is specially directed at this time. It is the practice of a number of railroads to leave considerable actual accounting in the hands of these departments, a balance sheet or other summary being sent to the head office periodically, for incorporation in the accounts of the company; indeed, in so far as the storekeeping department is concerned, the majority of roads may be said to adhere to this practice. Such a condition cannot be said to conform with sound business principles; it would be quite as logical for a departmental store, for example, to permit its various departments to employ and control their own staff of accountants, as it is for a railroad to permit its mechanical superintendent or storekeeper to do this. The impropriety is readily recognized in the one case, and it is difficult to justify it in the case of a railroad, where the expenditures, etc., are enormously larger than the largest departmental store.

The argument usually met with in justification of such methods is that the work is very largely of a technical nature, and it is necessary to be more familiar with material and its uses than is possible for the general staff of accountants to be. Whatever element of truth there may be in this claim, can, and should be, largely, if not entirely overcome by a proper classification and itemizing of material. One of the most essential features of material accounting forces itself upon our consideration right at this point; for whether the work is carried on in the stores, or in a central accounting office, such accounts should undoubtedly lend themselves to proper analytical process, in the same manner as the operating expenses do. Under any circumstances such an argument does not apply more forcibly, if as strongly, in justification of the storekeeping department doing the necessary accounting than in favor of the accounting department, for there is no branch of business life today which necessitates more exact knowledge of details, and correct principles of work than that of the accounting department. Extensive and varied training and experience is required to enable one to become proficient in such matters, and it is not possible for a storekeeper, be he ever so able, to properly meet such demands upon his time. This statement is made without the least desire to detract from the well-known ability of many forceful and energetic men holding, or who have held, such positions of responsibility in many of the railroads of this continent.

These are days of specialization in professions of every class and description, and it is but natural that we should look for and expect to find it in all branches of railroad work. Instances may be cited where an individual has been endowed with remarkable faculties of combining expert knowledge of a variety of professional duties, and such an

*From a paper read before the Canadian Railway Club.

individual will almost naturally be found in the high places of professional life; but to the ordinary mortal, to excel in one special line of work may be said to entail the full use of his faculties. Apart, however, from this subject of individual capacity must be considered the actual requirements of the profession—I am referring now to the railway profession—and only to a few—a very few—can the positions of president or general manager ever be more than a mere chimera.

Railroads today require a large number of specialists and few generalizers. Its organization resembles that of an army. One general in chief, two or more generals of divisions, a limited number of colonels, an increasing number of captains, and a further increasing number of lieutenants. Each officer must be proficient and possess sufficient initiative to enable him to act as though the entire result of any movement depended entirely upon his particular unit of command. Brilliancy is not absolutely essential, but a perfect knowledge, to enable a junior lieutenant to carry out his orders, is entirely necessary.

This question of the relationship of the accounting department to the stores and mechanical departments has been the subject of discussion at various conventions, also of consideration by many of the higher officials in the railroad world, evidence of which may be found in the appointment of auditors or other accounting officers, to take full charge of all stores and mechanical accounts, for we may safely assume such changes would not be made except after matured consideration. Of course, the question is one of comparatively minor importance to a number of our smaller railroads, for reasons which will at once occur to you.

Let us discuss for a few moments the duties, responsibilities, and qualifications of a storekeeper, and in doing this, we shall deal with only the general practice of roads whose storekeepers are the custodians of unused material. The larger question as to the duties of taking cognizance of all material until actually used may be left to some future consideration.

These duties bring him in constant touch with the entire operating department of a road. Locomotive, car, bridge and building, transportation, and other branches of the service are dependent upon him for supplying the necessary materials with which to carry on the work, whether it be construction of a thousand box cars, or the putting on of a patch to the side of a car, the building of cars, large monster locomotives, or the supplying of a tender truck box cover, wherever we find material being used, there also we find the storekeeper an interested party, and this interest entails upon him the need of cultivating a very close acquaintance with the heads and the requirements of the various departments. He is above all else an operating official, and should be able at all times to supply the material needs of the entire railroad. These needs are varied. No line of business can be excluded from its voracious maw. Hardware, glass, oils, paints, drugs, acids, the precious metals, lumber from the cheapest to the most expensive minerals, coals, coke, road and shop tools of every description, office supplies, flour, cement, silks, furniture, carpets, and so on, ad lib., all serve to appease, but never satisfy the hunger of our railroad systems. What kind of a man is required to cater to all these varied needs, and to cater intelligently, in order that he may furnish the maximum amount of satisfaction at a minimum expense to his employers; be ever ready to fill the orders and never overload himself with material which the aesthetic taste of a superintendent of motive power, or a master car builder refuses to attempt to digest? Surely a man to fulfill such requirements must be a paragon, surely such duties in themselves entail a large enough field for the most industrious cultivation, and the requisitioning for, receiving, storing, and disbursement of such material, calls for the very highest ability taxed to its utmost capacity.

Having those requirements in mind, let us glance briefly at the various steps one must tread before he can reach the topmost rung of the storekeeping ladder. Let us enter one of our large stores, and as we pass along we find our man trucking castings or unpacking boxes of various materials, maybe sweeping away refuse. Later on he is found loading material into cars or getting articles down from the shelves, assisting a storeman. He advances steadily, and is, perhaps, given charge of certain divisions or sections of the store house, and in the fulness of time is called upon to assume charge over the entire section or store.

Hitherto, his work has been manual, but now the stock cards and books engage considerable of his attention, for he is required to know the exact condition of his stock to enable him intelligently to place requisitions for the depleted material, he must know what the average monthly consumption is, how far his stock will provide for ordered requirements, what quantity if any he has on order, and whether through some special or irregular condition he is likely to be called upon for more than his normal supply. Thus it has become necessary for him to devote considerable time and attention to book records. This may be, and frequently is, an entirely new experience for him. Coupled to this, under the system which is still largely in vogue, he must devote his attention to the accounts of his store. The debits and credits are impressed upon him as important factors. For this purpose he engages a clerk, if the funds will permit, who does the necessary book work and accounting for him, and in his ignorance of the merest theory of such work, signs statements and records which are put before the management of a railroad.

It is general practice when a storekeeper keeps his own accounts, for him to keep those of the mechanical department also, the stores being very closely allied thereto, especially in a large plant where considerable manufacturing is carried on for road purposes. This necessitates his becoming a timekeeper as the largest disbursements of mechanical accounts are for labor. He must become an authority on distribution of such labor, and exercise a prerogative in connection with shop system, contract work, etc. Is it not hopeless to expect a man with a training which I have briefly outlined, to meet such varied requirements? With all respect to the large number of able general storekeepers on this continent, I affirm that they cannot devote their attention to storekeeping, accounting, and shop systems, with justice to either branch of the work. Indeed, there is very little, if any, attempt at doing this, as a matter of fact. It is largely a fiction. The clerk is held responsible for statements, etc., issued under a storekeeper's signature for the reason that the storekeeper himself has no time to attend to such matters, and not infrequently looks upon them as of very secondary importance, or is lacking in a proper appreciation of the value of such duties, and he almost naturally develops a tendency to protect the stores accounts at the expense of those of the mechanical department. Quite apart from the question of integrity of the departmental officials, a feeling of dissatisfaction inevitably underlies all questions of disputed costs. Speaking from experience, I have no hesitation in affirming that it is a simple matter to load an account with items which should never be charged thereto, and to so manipulate accounts as to afford more than ample protection to the storekeeping department.

There was a time in the recollection of many, when the necessity for proper accounting methods and men was not realized as it is today. Everything pertaining to the accounts, from the man who "wanted to know" to the underpaid clerk who was expected to "show," was accorded very

little consideration, and one can almost understand how it came about that the storekeeper was looked upon as a sufficiently informed and responsible person to take charge of accounting and timekeeping, but today, and I venture to say, never more than today, it is considered proper and necessary for this work to be handled by men whose minds have been thoroughly trained thereto. A man who is held responsible for a proper system of timekeeping must have an organization at his back to properly handle all the varied problems relative thereto, and must be expert in matters of shop practice, the many vagaries of which have received much attention and investigation during the past few years of agitation and labor unrest.

If we look at the mechanical department, locomotive and car, we shall find the same high standard requirements of efficiency and capacity in all that relates to the practical working of these departments as was found to be necessary in the storekeeping department. In fact, bearing in mind the great organized efforts which are being made to raise the standard of apprenticeship in the various shops throughout the country, and the hard course of training which an efficient mechanic has to undergo before reaching the position of, say gang or shop foreman; and remembering that our universities are instinctively availing themselves of the vast openings offered for college trained men for the higher official appointments, and are educating and training young men in theory and practice of the mechanical department of a railroad, we can safely say the standard of excellence obtained is higher than in almost any other branch of railroad work. They must keep up with the times. The pressure for improvements or betterments making for greater efficiency in power and rolling stock, improved shop practice, improved tools and machinery, improved facilities at terminals for handling the power, is increasing, and is brought about by the efforts of the management to obtain cheaper and yet more efficient results, in order that a proper equilibrium may be maintained between revenue and expenses. Yet we find, with few exceptions, that the practice is almost invariably for this department to have its accounting taken care of by another department, either the storekeeping or the auditing, I believe as much from choice of the mechanical officers themselves as from a recognition by the various managements of the sound business principle that authority over the accounts of a department must be separate from the authority governing the practical working of that department. Such a rule has behind it the undoubted authority and wisdom of those whose duty it has been to ensure the most perfect results and records of business transactions.

What of the duties of the auditor in his relations with the mechanical and the stores departments? Labor is, of course, the important factor in all mechanical accounts, and the ensuring to every employee in all shops and roundhouses, etc., a just accounting for his time must receive first consideration. At the same time necessary precautions against fraudulent claims for time not worked must be taken. It is also of prime importance that such time is properly distributed, or, in other words, that the accounts for which labor is performed is charged therewith, so that the correct cost of an engine or group of engines, a car or group of cars, going through the shops for repairs or construction, etc., may be determined accurately. The cost of articles manufactured, such as bolts, nuts, forgings, wheels, castings, etc., must be compiled in such a manner as will make comparison with the market prices of such articles a simple proposition. No great advantage can accrue in manufacturing articles which can be purchased in the open market as cheaply or cheaper than you are making them for. "Shop costs" systems have received a great deal of enterprising attention from what is yet a new branch of commercial life, the shop cost engineering profession. An elaborate system of store orders, requisitions, and labor distribution is entailed and much detail work of an accounting nature is necessary.

Where piece work or contract systems are in force it is necessary that the auditor should satisfy himself as to the completion of work paid for, in order that he may not certify for payment any unearned monies; but it must be recognized that much of this class of work requires mechanical experts to pass upon, and in many cases all the auditor can do is to see that proper safeguards are set up to prevent fraud or collusion. Other questions relating to labor, particularly those relative to shop efficiency, and job time records, come more or less under the observation of the auditor; but I am of the opinion that the less his department has to do with such matters the better, alike for himself and the mechanical department. They are the legitimate work of the mechanical staff, shop superintendent, foreman, clerks, and specialists, as the results obtained are purely of interest for economical reasons to the shops themselves, and all responsibility for their carrying out or development must devolve upon the shops.

In none of these matters is the storekeeper an interested party, for even the item of labor on manufactured material, if properly cleared, does not affect his stock balances, whether the charges are correct or not. Both the storekeeper and the mechanical department, however, are concerned in all questions relating to material consumed, and the essential duty of the auditor in this regard is to see that the storekeeper is properly credited with all material delivered to or taken by the shop forces. At the same time he will see that the accounts for which material is charged are properly covered by approved requisition, and the purpose for which material is required is clearly set forth. If, as sometimes occurs, any unusual quantity is called for, the matter should be investigated, and he should satisfy himself as to the special requirements. Only such material as may be required for current needs should be requisitioned for, and bulk issues should not be allowed. He will endeavor in every way to protect the stores by seeing that they are credited with the value of all issues, and, at the same time, must be equally satisfied that nothing is charged against the mechanical department, except that which is justly chargeable thereto.

It should be clearly understood that no advantage can accrue to the storekeeper by overcharging other departments, and with careful checking of prices by the auditor there could not exist much opportunity for doing so, should there be any such desire.

Careful inventories of material on hand should be taken at least once a year, and from his records the auditor should be enabled to inventory a considerable portion of every storehouse much more frequently. Should there appear from such inventory a surplus or deficit, it should be transferred to the general books of the company for funding purposes, as an offset against future possible shortages or overages, or application of credit or debit made to the accounts which have been charged with material since previous inventory, pro rata according to the amounts charged.

As regards accounting for material received from merchants, the auditor will see that proper acknowledgment is received from the storekeeper of all such items, and by having communication with all requisitions, will satisfy himself that authorized officials have approved the purchasing of same. He will see that the records of its receipt are kept in such a manner as will ensure against the passing of duplicate invoices or acknowledgments, and also that proper stock book records are maintained of all intake or output of the various items of material. At the most convenient time such records must be gone over with a view of satis-

fying himself as to surplus or obsolete material, or undue quantities of any article being carried at one point on the road while purchases of similar material are being made elsewhere. Obsolete material should not be destroyed, sold, or turned over to the scrap pile, until the authority of the department for whom it was originally procured is obtained, as the storekeeper's accounts must receive credit for whatever loss is sustained, and the expense be borne by this department.

Inventories should, as far as possible, be taken by auditors independent alike of the stores' auditor and the storekeeper, thus obviating any possibility of irregularities, the desire being at all times that the most accurate records possible be obtained. In companies where the consumption of material represents from $100,000 up to $2,000,000 per month, there is ample scope for the auditor without infringing on the natural field of the storekeeper's activities, which pertain to the receipt and disbursement of material, and maintenance of proper stock records of same; or of the mechanical department, whose duty it is to see that proper material is supplied for their requirements, and proper and economical use made of same. Economy of operation of the stores department is usually determined by taking the percentage which the amount of "stock issues" bears to the total "stock on hand," at the first of the month plus the "receipts" during the month. While not mathematically correct this method, no doubt, gives a fair line on the results obtained. At all events for comparative purposes, year by year, it is absolutely good, while month by month the variable conditions of business require to be considered. Except in special cases, where, for instance, material must be purchased abroad, the stock should not average more than sixty days' supplies, and in a large number of items thirty days is sufficient, but forethought and interchange of ideas and plans between the storekeeper and the mechanical department is at all times desirable, and even necessary, if this standard is to be maintained, also it should be remembered that question of economical operation can be driven so far as to entail distinct loss to the companies. The auditor and general storekeeper should be vitally interested in these percentage figures, as they afford a ready means of determining the efficiency of the storekeeper. Continued poorness in this respect is a matter that calls for the general storekeeper's intervention, and sometimes a change of departmental officials.

Auditing or accounting by an independent officer should make for real efficiency in the departments concerned. I speak for myself in this matter as much as with regard to the stores and mechanical departments, and I welcome an outside auditor, who may be authorized to do so, going over the methods and analyzing the principles upon which the work of my department is conducted; showing up any loopholes or weak spots, in order that whatever remedy is found necessary may be applied. Not only this, but an auditor must keep his mind in a constant state of receptiveness. Many a good suggestion emanates from unexpected quarters, and the practical knowledge of a shop superintendent, a foreman, or a clerk should not only not be ignored, but should be sought and encouraged with the view of developing the utmost efficiency in all that pertains to the employer's interests. Differences of opinion will, and must exist, and in such cases the auditor cannot but be paramount in his rulings unless a higher authority intervenes. This efficiency is after all the "raison d'etre" of the existence of the auditing department as it is today, and higher ideals of workmanship must naturally develop as the efficiency of the accounting department is evidenced in the various departments of railroading. The "fruits" themselves must be the evidence of the good workmanship, and not the self-compiled blue prints or glowing picture books with the halo beautifully worked in to add the necessary touch of sanctity to the artist, with the horns prominently displayed in the caricature of his unfortunate rival. Rivalry and competition are the soul of trade, also of railroad efficiency, and are, therefore, eminently desirable, but honesty and integrity must go hand in hand therewith. Systems which lay bare all attempts to mislead shareholders, directors, presidents, or whoever it may be, and place before them only honest unbiased results must be more and more appreciated and ever increase in value to the vast corporations in which they are employed; and I believe you will find in such corporations more integrity and greater efficiency in all departments; officers and men who are ready to be judged by the high quality of their accomplishments, and who recognize the desirability, and appreciate the arduous and somewhat thankless tasks of the accounting department.

The present status of the science of auditing and accounting is not at all final. There cannot be any finality in connection with it any more than with other branches of railroad science. Development must continue.

HL CONTROL FOR ELECTRIC LOCOMOTIVES.

In starting and accelerating heavy freight and passenger trains, the current taken imposes very severe duty on the average "K" or "L" type controller. By the use of auxiliary contactors this condition can be somewhat relieved but the weight and space requirements of the large "K" or "L" types in addition to those of the contactors, make it desirable to use a Westinghouse HL type of control arrangement.

This type of control has been tried out on a number of locomotives and in every instance has given excellent satisfaction. A few of the roads using this control on locomotives are: Hoboken, Shore Road, Washington Railway & Electric Company, British Columbia Railway, Northern Electric Railway, Indiana Traction & Terminal Company, Frederick Railroad, Portland Gray & Lewiston Railway, and all the heavy steam roads such as the Pennsylvania Railroad, New York, New Haven & Hartford Railroad, Hoosac Tunnel on the Boston & Maine, New York, Westchester & Boston Railway; Rock Island Southern, Grand Trunk Railway, Sarnia Tunnel, Spokane & Inland and others.

A group of eight switches is provided in the controls for quadruple 75 h. p. motors and two or more additional switches are provided for motors of greater capacity. The Westinghouse HL type of control is peculiarly adapted for use on high voltages for the reason that the contacts are held together pneumatically under great pres-

Interior of Electric Locomotive Cab, Showing HL Control Switch Group.

sure irrespective of line voltage, and are separated by powerful springs, thus assuring positive action. Through the use of heavy pressure on the contacts great momentary overload capacity is secured. An exceptionally effective magnetic blowout is employed and the circuit is opened with little or no burning. The effectiveness of HL control is not impaired by line voltage variations, within any range likely to be encountered in actual service, due to the fact that when operating with minimum trolley voltage the switches open and close with the same force as when operating with maximum trolley voltages.

JACOBS-SHUPERT FIREBOX TESTS.

Commencing February 1st, the Jacobs-Shupert U. S. Firebox Co. will run a series of tests, on its locomotive firebox, at Coatesville, Pa. The tests have been outlined by and will be made under the direction of Dr. W. F. M. Goss, dean of the engineering school of the University of Illinois, who will also prepare the report of the same.

These tests are to be made in the presence of whomsoever may desire to witness them. They are to be conducted at Coatesville, Pa., where a special testing plant has been erected. Upon the conclusion of the efficiency tests, the boilers are to be removed to a point about one-half mile distant, and prepared for the low water tests. Provision will be made for spectators to observe these tests without danger of injury in case of explosion.

There have been provided two boilers, identical in construction except for the fireboxes. The principal dimensions are given below:

	Jacobs-Shupert Boiler Inches.	Stay Bolt Boiler Inches.
Outside diameter of shell of boiler at front end	70	70
Diameter of throat of boiler	83⅞	83⅞
Number of tubes	290	290
Length of tubes	218	218
Diameter of tubes	2¼	2¼
Inside length of firebox	109⅝	109$\frac{11}{16}$
Inside width of firebox	76⅜	76¼
Height of top of crown of firebox above bottom of mud ring	73$\frac{3}{16}$	74$\frac{13}{16}$
Number of sections composing firebox	11	———
Diameter of radial stays	———	1

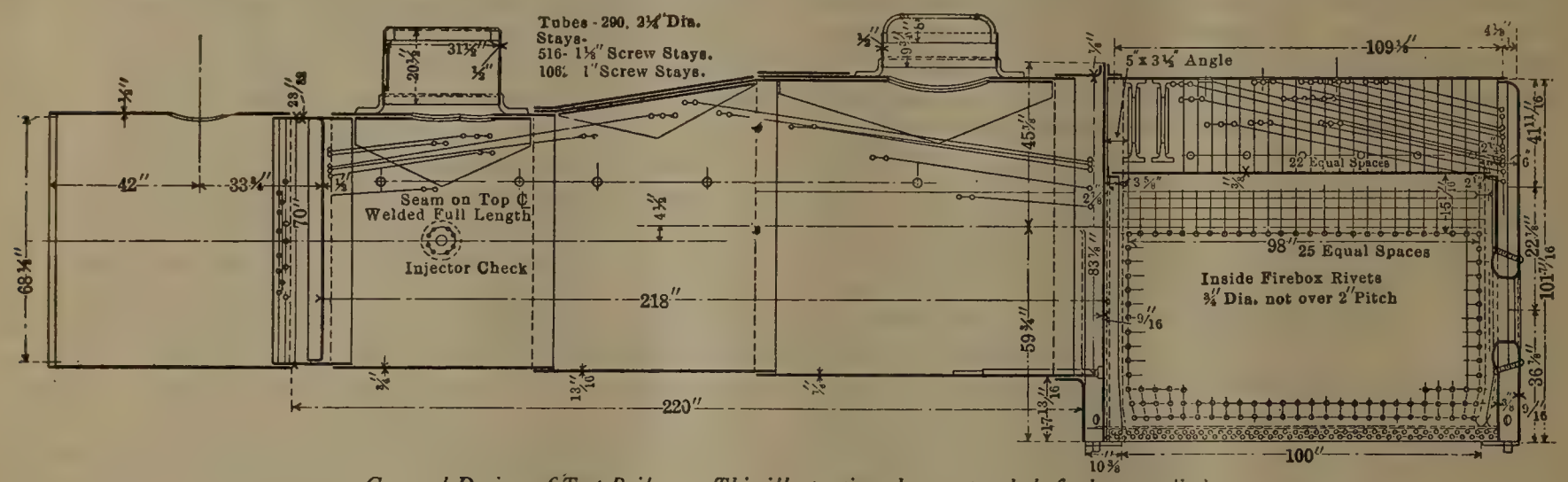
Each firebox compartment is completely isolated from its tube compartment by means of an extension of the flue sheet; and the first series of tests, known as series "A," will concern the determination of efficiency data for each firebox independently of its tube compartment.

Upon the conclusion of the series "A" tests, it will be necessary to dismount the boilers and disconnect the fireboxes and remove the blind diaphragm consisting of the extension of each flue sheet; and the boilers again will be put together and remounted on the testing plant for the test of series "B," during which, therefore, each boiler will be in its normal condition. It is estimated that about two weeks' time will elapse between the tests of series "A" and the tests of series "B."

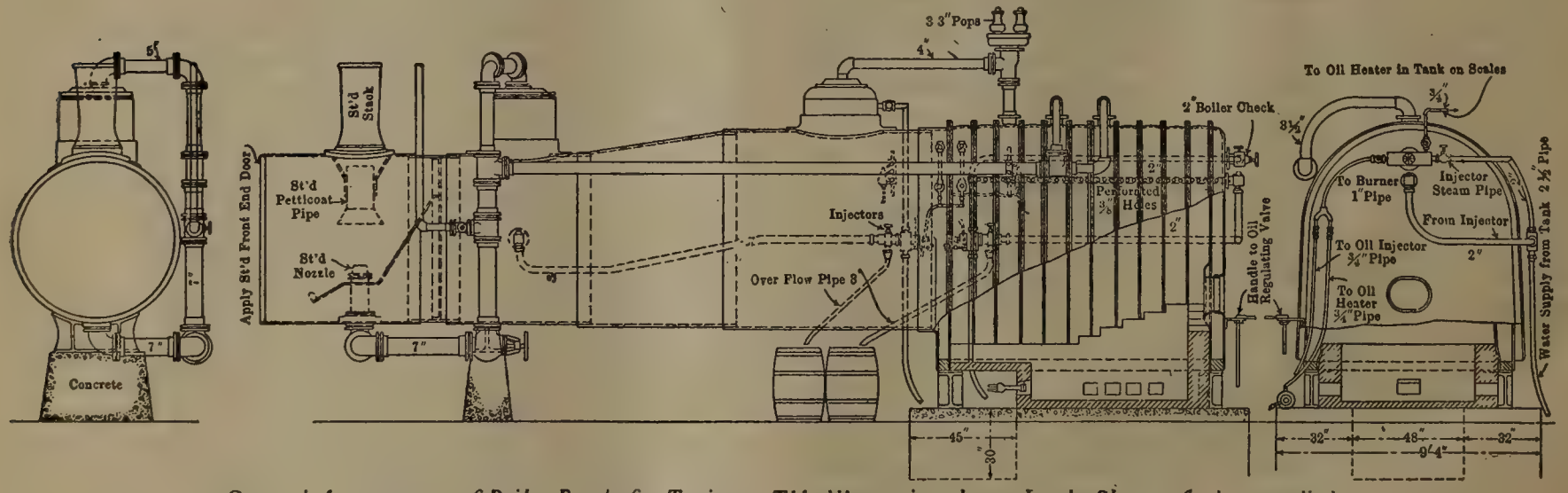
The boilers are designed for locomotive service and are, so far as possible, identical in their general dimensions. They differ from each other only in the construction of the firebox and its staying.

Three different series of tests are to be made, hereafter referred to as those of series A, B and C respectively.

Series "A" will consist of comparative tests to determine the relative amount of heat absorbed by the fireboxes of the two boilers under similar conditions of operation. The original construction of each boiler provides a diaphragm which will separate the water space of the boiler into two compartments, one of which includes the tube surface and the other the firebox surface. In the course of the tests these compartments are to be



General Design of Test Boilers. This illustration shows stay bolt firebox applied.



General Arrangement of Boiler Ready for Testing. This illustration shows Jacobs-Shupert firebox applied.

separately fed with weighed water, an arrangement which will permit of a separate determination of the heat transmitted by the firebox and by the tubes respectively. The series will consist of three evaporative tests upon each boiler. Tests No. 1 of this group will be made under low power; tests No. 2 will be made under average or normal power; and tests No. 3 will be made under maximum power. It is expected that the results obtained from these tests will disclose the difference in the heat absorbing capacities of the two fireboxes in question. The results will also give certain facts which American engineers have long wished to know with reference to the relative capacity of a unit area of firebox heating surface as compared with the capacity of a unit area of tube heating surface.

Series "B"—The boilers will then undergo such reconstruction as may be necessary for the removal of the diaphragms. This accomplished, they will in each case be entirely typical of normal boilers in present day service; that is, one will be a normal stay-bolt boiler and the other will be a normal Jacobs-Shupert boiler. Each boiler will then be subjected to a series of three evaporative tests, under rates of power similar to those employed in series "A." These tests will establish the evaporative efficiency and the capacity of the two boilers in question. In addition to data usually secured in ordinary boiler testing, it is proposed to attempt, by the use of special equipment, and also through the employment of expert assistance, to secure some information concerning conditions affecting the circulation in the two boilers. A comparison of the results of these tests should give an accurate measure of the relative performance of the two boilers under all possible rates of power.

Series "C"—After the completion of the efficiency tests, the two boilers are to be arranged for a test of strength under low water conditions—hereafter to be referred to as low water tests. The boilers are to be set in a location where their explosion would result in no harm to surrounding property and are to be equipped with instruments of observation located within shelter, to provide for the safety of the observers. In the course of these tests, the boilers are always to be operated at a predetermined rate of power, which rate shall be a close approach to the maximum that the boiler is capable of delivering. Each boiler is to be subjected to a progressive series of tests until the destruction, or serious deformation, of the firebox occurs, the series to begin and proceed substantially as follows:

Tests No. 1. In anticipation of this test, the boiler is to be brought into action and operated under normal conditions at the predetermined rate of power. These conditions secured, the feed is to be cut off until the water reaches the level of the upper surface of the crown sheet. The feed pump will them be started and the water level restored, after which, as a precaution insuring safety to observers, the pressure in the boiler will be reduced and a careful examination made of all parts. If necessary, the boiler will be cooled and even emptied after these tests. If minor defects appear, such as leaky staybolts, they will, so far as possible, be corrected before proceeding with the next test.

Test No. 2. Test No. 2 will be similar to Test No. 1, except that the water level will be dropped to a point one inch below the upper surface of the crown sheet.

Test No. 3. Test No. 3 will be similar to Test No. 1, except that the water level will be reduced to a point three inches below the top of the crown sheet.

Test No. 4. Test No. 4 will be similar to Test No. 1, except that the water level will be reduced six inches below the top of the crown sheet.

Test No. 5. Test No. 5 will be similar to Test No. 1, except that the water level will be reduced twelve inches below the level of the crown sheet.

The series of tests will be continued for each boiler until the defects are so serious as to require the reconstruction of the firebox.

Fuel—The fuel for all tests will be oil, the use of which will permit the satisfactory operation of fires during the low water tests, when the observers are at distance from the boiler. Supplementary tests with coal are contemplated.

Those interested in the tests are welcome to remain in Coatesville from the beginning until the end of the work, but it is realized that there will be many who are particularly interested in some certain phase of the tests or in some particular series. While it is impossible to state on just what date any certain test will be made, prospective visitors will be advised as early as possible.

A letter or telegram addressed to the Jacobs-Shupert United States Firebox Co., Coatesville, Pa., will receive prompt reply.

The tests of series "A" will begin on February 1, 1912. The low water tests will begin on or about April 1, 1912.

HEAD END ELECTRIC TRAIN LIGHTING.*

By C. R. Gilman, Chief Electrician, C., M. & St. P. Ry.

While the general system of head end train lighting is the same as used 15 years ago, there have been a number of improvements and changes made. These, with the adoption of the new types of electric lamps, storage batteries, fixtures and reflector glass ware, makes this system very efficient and reliable, where first-class uniform lighting is required on a heavy train.

While some are acquainted with the method of operation of a head end lighted train, a short description is thought necessary to enable others to better follow the paper. A head end system is one where a steam turbine driven dynamo is placed either on the locomotive or in the baggage car, taking steam from the locomotive to operate it. Auxiliary lighting is maintained, when locomotives are changed or cars stand in terminals, by two, three or four storage batteries, depending on the number of cars in train. These batteries float on the main train wires in parallel with the dynamo, lighting the lamps should any thing happen to dynamo, turbine, steam hose or train part and pull out a connector.

One of the advantages of the head end system is that the number of cars put on the train to light is limited only by the number the locomotive can haul. I am, therefore, going to take a seventeen mixed car train as an example.

Equipment.

One 25 kw. Curtis tubo generator, 3,600 R. P. M. 110-125 volts.

Switch board and dynamo connection in baggage car.

Automatic loop connectors.

Standard 2-compartment tray of train lighting batteries.

The train is made up as follows:

1 dyanmo baggage car	14 lamps
2 mail cars	66 lamps
1 mail tender	8 lamps
1 Comp. sleeper	60 lamps
1 12 section sleeper	80 lamps
1 buffet car	82 lamps
5 12 section sleepers	400 lamps
1 dining car	42 lamps
1 parlor car	42 lamps
3 coaches	78 lamps
17 cars	872 lamps

Eight hundred and seventy-two 104 volt 8 c. p. lamps are used and the total lamp load is 20,627 watts. The losses in machine and train lines is 22 per cent so the load on dynamo is 25,219 watts, which is the full capacity of the machine.

In actual operation we seldom get continual steam pressure enough to operate this load, so allow the storage batteries to help out until the number of lights is reduced, as passengers retire for the night.

Previous to April, 1910, we connected our batteries in par-

*From a paper read before the Western Railway Club, Jan. 16, 1912.

allel with the lamps on the two outside mains, allowing them to float on the lamp system. Later when the sleeper passengers had retired and the load was largely reduced we raised the dynamo voltage to 118 or 120 and gave the batteries what is known as a floating charge. One hundred and twenty volts is not high enough to properly charge the batteries, but was as high as we deemed advisable to run our lamps. We found, however, that the batteries took a fairly good charge at 120 volts and with an initial charge in the yard at full capacity twice a month they remained in good condition.

Early in 1910 I went seriously into the subject of charging batteries on the trains, as our charging plants are small and the number of batteries to charge continually on the increase. Charging batteries en route require plenty of current, lamp regulation and means to determine the amount of charge and discharge the batteries are receiving.

While there are a number of very good automatic lamp regulators on the market, they are quite expensive and each car on the train has to have one. Owing to the large number of cars required to make up this train, the cost of automatic regulators would have been over $1,700, and we cast about to see if we could not substitute some means to accomplish the desired results at less expense. Without altering or adding to the present three wire standard this we have done by connecting the battery to the same main wires as the dynamo and placing a hand operated resistance in the main lamp return wire, in baggage car. This lamp resistance is brought into use by opening the connector loop in rear of train and closing it on switch in baggage car.

On account of the high steam pressure needed to operate the dynamo, the baggage car is run next to the locomotive. On this train there are three mail cars without end doors between it and the train. Our baggagemen therefore, cannot get into the train while it is in motion and as they operate the electric lighting, it is very necessary for them to have simple rules to run by. I will therefore quote our charging instructions as they fully explain the operation of charging the batteries.

Instructions to Dynamo-Baggagemen.

At about midnight or when lamp load has fallen to the minimum begin charging.

Arrange previously with rear-brakemen to open rear connector loops.

Better arrange to do this at some station. Just before arriving at this station throw in your front end loop, otherwise train will be in darkness as soon as rear loop is opened.

Now, with everything running as it should be, put volt meter switch on lamps, throw in first point of large lamp resistance. That will lower voltage, raise lamp voltage to 104. Now read dynamo voltage, if it stands at about 128 or 130 let it alone; if not, throw large resistance to No. 2 and again raise lamp voltage to 104. Continue this until you have about 104 volts on lamps and 128 to 130 volts on dynamo. Let it run now until ampere load has fallen to about 5 or 10 amperes for each battery back of your car in addition to the lamp load. Then shut down dynamo. Pay particular attention to the amount of steam necessary to operate the dynamo and call for as little as possible. This is very important. It saves coal, saves steam for the locomotive (where it is sometimes badly needed) and saves bursting steam hose, an expense to the company, delay to the train, and trouble to yourselves.

With an automatic loop connector to open the loop, it is only necessary to insert the male connector. Therefore, if all connectors are in place there are no loops in the train except the one on rear of last car. Should train part from accident or is parted for switching, as soon as male connector is taken down the automatic loops immediately set, forming a circuit for the current, either from the dynamo in front, or battery on last part of train.

The total cost of equipping a train for this system is $67.50. This includes hand lamp resistance, automatic cut out and extra main car feeders brought from roof main down to switch box and connections made in 4-battery cars.

This system of charging has cut down the lamp renewals 30 per cent, has enabled us to do our charging on the road, and keeps the batteries in good condition.

The controlling of the charge is done by having ampere hour meters in circuit with each battery. These are read at terminals and baggage men advised to charge more or less as the conditions demand.

Lighting a 17-car train having over 800 lamps, and being about a quarter of a mile long is no mean undertaking, and on account of the heavy all night load 75 amperes it was found hard to keep the batteries charged and give satisfactory illumination. I therefore suggested to our people that we reduce the load on this train by adopting 60 volts, and using tungsten and tantalum lamps.

Many of you are aware that for more than two years I have been a strong believer and an earnest worker in endeavoring to bring about a standard of 60 volts on all the head end lighted roads, and while most electrical men can see advantage in it, the mechanical people so far on some roads have not taken it very seriously. It gave me great satisfaction, therefore, that our people allowed me to try it out on the Pioneer Limited.

On November 10, 1910, this train arrived in the yard at 11:00 A. M., 110 volts, and when it left at 5:30 P. M. had been changed to 60 volts, lamped and tested. The operation that night was all that was expected and the lighting was beyond reproach.

To convert the 110-volt dynamo into a 60-volt machine, we placed an extra field rheostat in series with the old one and a shunt across the compound field terminals. I had previously tested out a number of these generators and knew just what to do with them. The cost of converting this machine from 110 to 60 volts is $7.50.

Diagram No. 1 is a test sheet of this train at 64 volts.

It will be noted by comparing it with test sheet No. 2 of 104 volt train that the amount of steam required to operate dynamo averaged about 18 pounds less. That the battery charging current available was 50 per cent greater. The voltage was more uniform, 12 C. P. lamps were used instead of 8 C. P., increasing the light on train 60 per cent.

Now let us compare the operation costs of the two systems.

As there are six items that differ in each train operation, we will compare them only.

Consumption of steam.	Lamp renewals.
Weight hauled.	Yard labor.
Battery depreciation.	Total candle power.

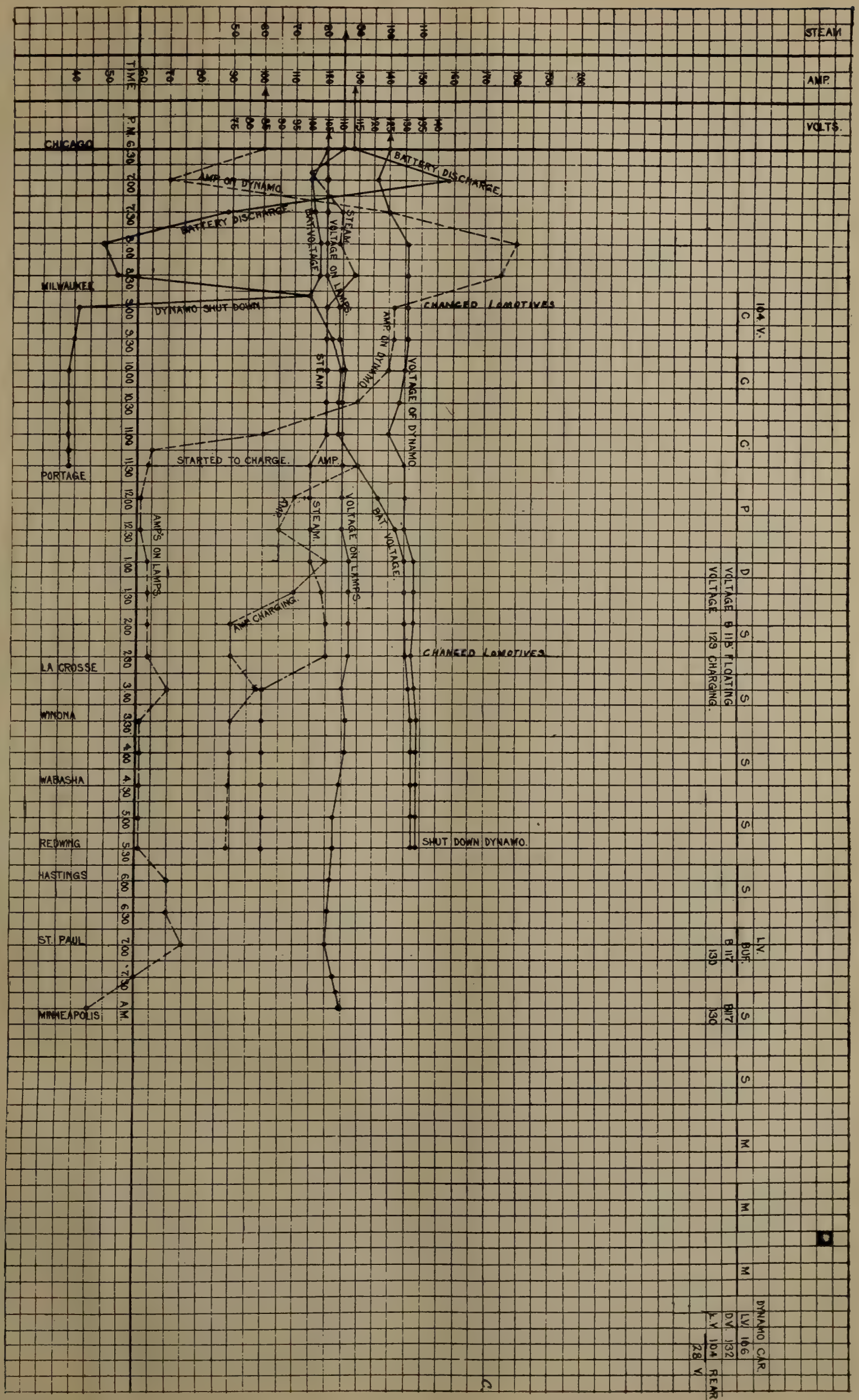
110 Volt Train, See Sheet No. 2.

We find that on a 110 volt train the average load was 14.96 kw.

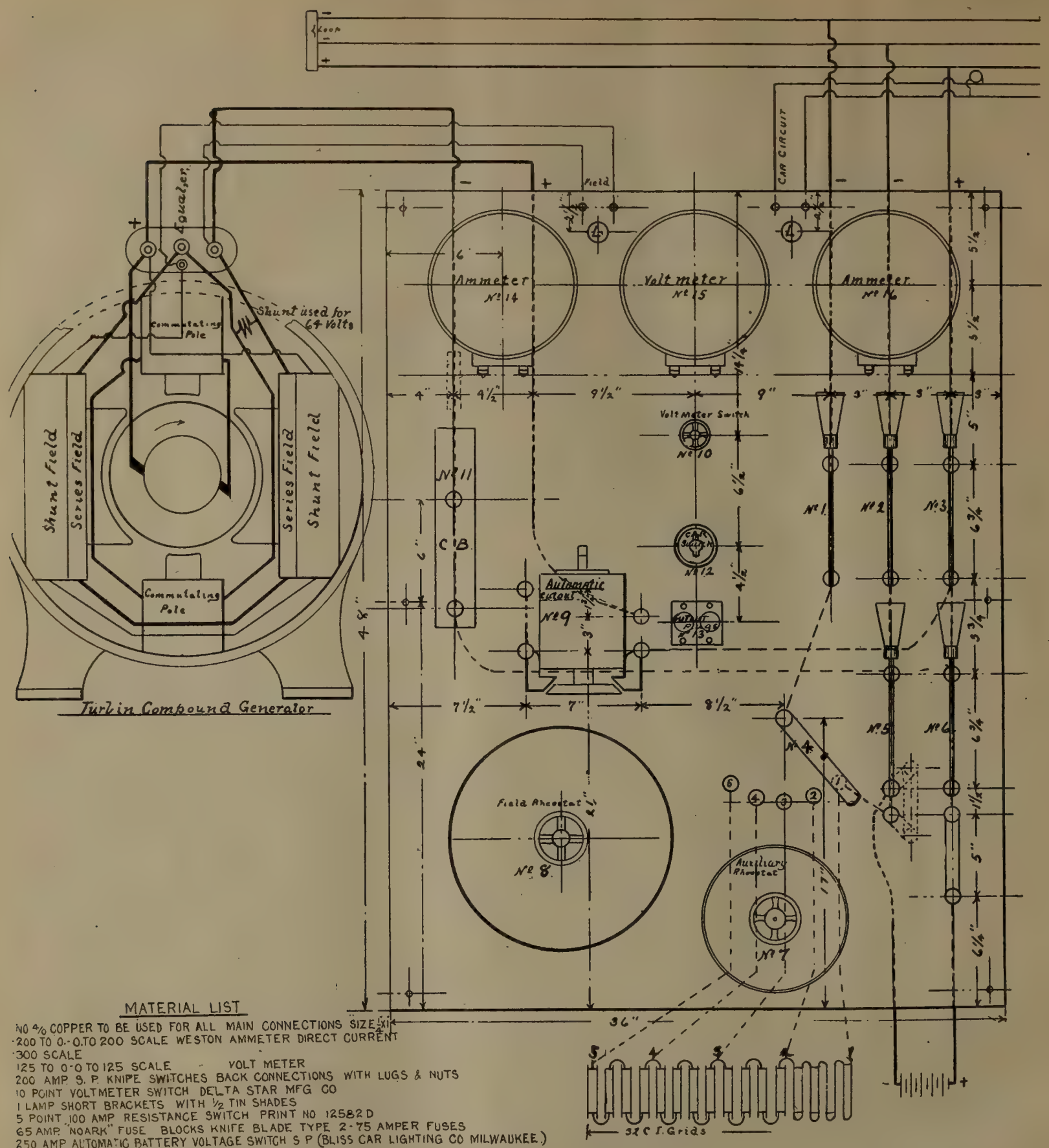
Taking tests made by Mr. Wray, Bulletin No. 268, University of Wisconsin, for the efficiency of the turbine, we find that at 15 kw. load 88 lbs. of steam was used per kw.h. 88x15 kw. equals 1,320x19 hours per trip equals 250,080 lbs. steam used. This divided by 5:5 lbs. water evaporated per lb. of coal equals 4,560 lbs. as used per trip 182 trips per year equals 829,920 lbs. coal divided by 2,000 (lbs. per ton) equals 415 tons multiplied by $2.00 equals $830.00.

Cost of Hauling Batteries.

Four sets of 54 cells each, 216 cells at 173 lbs. each equals 37,368 lbs. divided by 2,000 (lbs. per ton) equals 18.68 tons, 820 miles per trip multiplied by 182 trips multiplied by 18.68 equals 2,787,803 ton miles multiplied by .0015 cents per ton mile equals $4,181.70.



Test Sheet No. 2—Pioneer Limited Lighting System, Chicago, Milwaukee & St. Paul Ry.


Equalizer
Shunt used for 64 Volts
Commutating Pole
Shunt Field
Series Field
Series Field
Shunt Field
Commutating Pole
Turbin Compound Generator
Field
CAR CIRCUIT
Ammeter No 14
Volt meter No 15
Ammeter No 16
Volt Meter Switch No 10
No 11
C B
Automatic Cutout No 9
No 12
No 1
No 2
No 3
No 4
No 5
No 6
Field Rheostat No 8
Auxiliary Rheostat No 7
32 C P Grids
Resistance to be placed overhead in car
MATERIAL LIST
NO 4/0 COPPER TO BE USED FOR ALL MAIN CONNECTIONS SIZE xi
200 TO 0-0 TO 200 SCALE WESTON AMMETER DIRECT CURRENT
300 SCALE
125 TO 0-0 TO 125 SCALE VOLT METER
200 AMP S. P. KNIFE SWITCHES BACK CONNECTIONS WITH LUGS & NUTS
10 POINT VOLTMETER SWITCH DELTA STAR MFG CO
1 LAMP SHORT BRACKETS WITH ½ TIN SHADES
5 POINT 100 AMP RESISTANCE SWITCH PRINT NO 12582 D
65 AMP "NOARK" FUSE BLOCKS KNIFE BLADE TYPE 2-75 AMPER FUSES
250 AMP AUTOMATIC BATTERY VOLTAGE SWITCH S P (BLISS CAR LIGHTING CO MILWAUKEE.)
30 AMP PLUG CUTOUT DOUBLE POLE
10 AMP D P SNAP SWITCH
GRID RESISTANCE (TYPE NO 445) 8-GRIDS TO EACH SPACE 32 IN ALL G & H CO
BOARD TO BE MADE OF EBONY ASBESTOS ¼ THICK

Arrangement of Apparatus, Head-end Lighting System.

Battery Depreciation.

Battery depreciation figured at 15 per cent....$679.40
Yard labor 554.80

Lamp Renewals.

Carbon lamps cost 20 cents each, 5,232 lamps were used, which equals $1,046.40.

60 Volt Train, See Sheet No. 1.

The average load is 10 kw., the average steam used is 105 lbs. per kw.h.

Figured in the same as for the 110 volt train the cost of coal for this train was $660.00.

Cost of Hauling Batteries.

Four sets of 32 cells each 128 cells at 173 lbs. equals 22,144 lbs. or 11 tons equals $2,503.80.

Battery Depreciation.

Battery depreciation at 15 per cent $403.20.

Yard Labor.

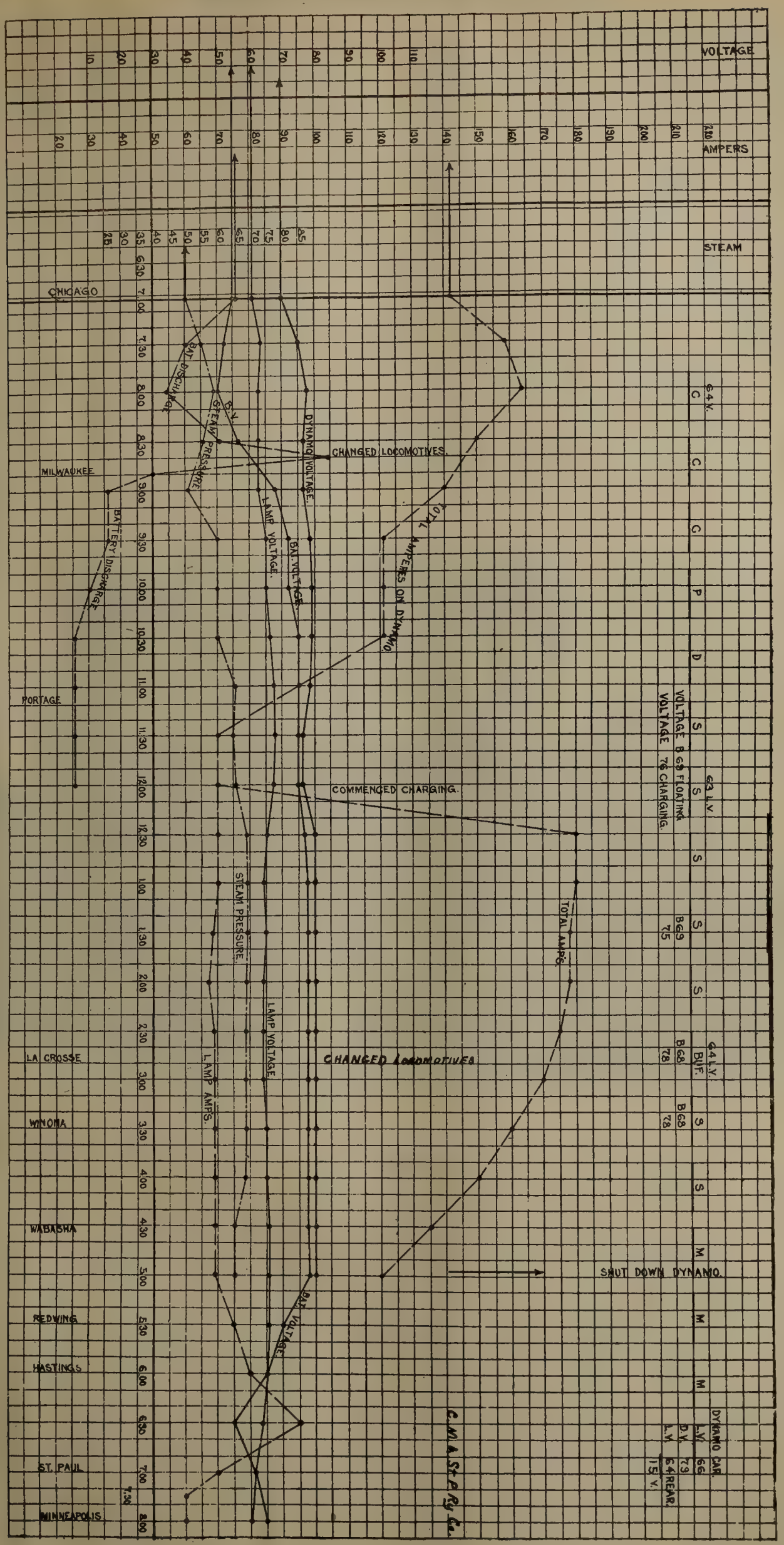
While there are 40 per cent less batteries to handle the other work on the train remains the same, so I have taken 65 per cent of the yard cost of the 110 volt train which amounts to $360.12.

Lamp Renewals.

Forty-seven cents each is average cost of tungsten and tantalum lamps. We have figured 10 per cent more lamps used than on the 110 volt train. Cost of lamps $2,704.85.

Table of Costs, 110 Volt Train.

Coal for operating dynamo	$ 830.00
Batteries, cost of hauling	4,181.70
Battery depreciation 15 per cent	679.40
Yard labor	554.80
Lamp renewals	1,046.40
	$7,292.30



Test Sheet No. 1—Pioneer Limited Lighting System, Chicago, Mil waukee & St. Paul Ry.

Table of Costs, 60 Volt Train.

Coal for operating dynamo	$ 660.00
Batteries, cost of hauling	2,503.80
Battery depreciation	403.20
Yard labor	360.12
Lamp renewals	2,704.85
	$6,631.97
Total saving by 60 volt system	$ 660.33
Total C.P. 110 volt train	6,976
Total C.P. 60 volt train	10,464

While the difference in operating expense is not great, the lighting service is 100 per cent better. In fact, our operating troubles have been so greatly reduced, that where we formerly received constant reports of poor lighting, we seldom if ever now get a report of that kind.

Closing, I wish to say that the interchange of cars, on our western roads is on the increase, and a uniform voltage for the head end lighted trains is more than ever necessary, and I hope the day is close at hand when those roads that have not adopted the 60 volt system as standard will soon see their way clear to do so.

The Guelph Radial Railway locomotive is ruggedly built. The frame is of channel iron construction, and the cab is substantially built of clear ash fitted together with joint bolts and corner plates. The trucks are of the standard Baldwin electric M. C. B. equalizer-bar type with chilled cast-iron wheels.

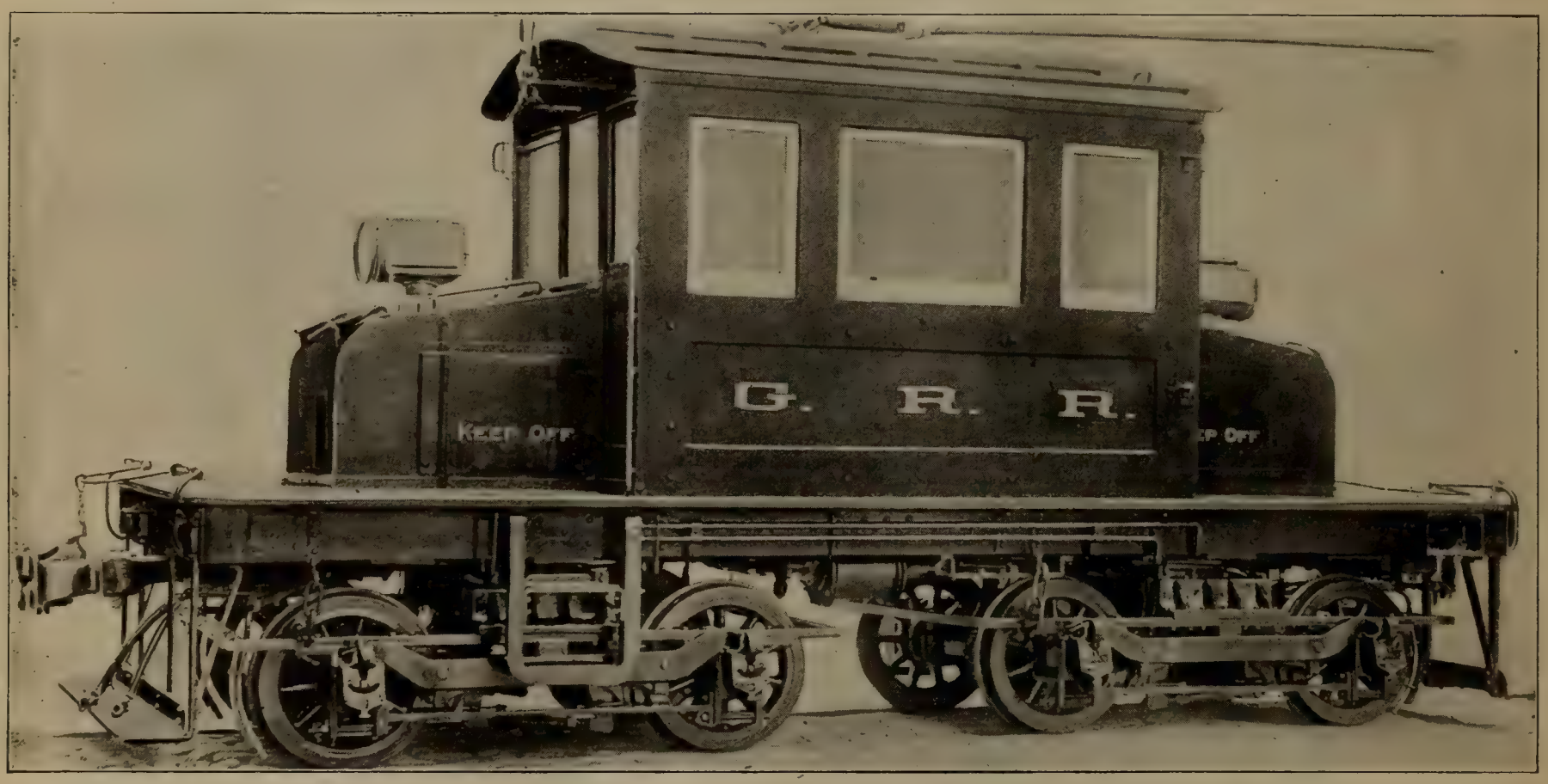
The electrical equipment consists of four type No. 101-B-2, 40 h. p., 500 volt Westinghouse railway motors and K-28-B control. It is also equipped with Westinghouse automatic and straight air brakes with outside equalizing driver brakes.

The principal dimensions are:

Length over end sills	23 ft. 0 in.
Width over all	8 ft. 0 in.
Truck centers	12 ft. 0 in.
Rigid wheel base	6 ft. 0 in.
Total wheel base	18 ft. 0 in.
Wheel diameter	33 in.

The hauling capacity of this locomotive is given in the table below:

Number of cars weighing 45 tons with load at 10.75 miles per hour at 500 volts.



27-Ton Electric Locomotive, Guelph Radial Ry.

27-TON ELECTRIC LOCOMOTIVE, GUELPH RADIAL RAILWAY.

The Guelph Radial Railway, Guelph, Ont., has recently purchased a 27-ton Baldwin-Westinghouse direct-current locomotive. The cab, trucks and all mechanical parts were built by the Baldwin Locomotive Works, and the electrical equipment, including motor and control, was furnished by the Canadian Westinghouse Co., Limited, of Hamilton, Ontario, after the design of the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

This locomotive is compactly built and may be used for freight and switching service. Interurban and city railways are using locomotives like this one, and larger for various kinds of service, for a road's earning capacity can be materially increased by using locomotives to haul freight during the night or idle hours, thus improving the load factor. Many city roads also use similar locomotives for hauling construction material and refuse to dumping grounds.

Straight Level Road	*Maximum Grade ½%	1%	2%
17 cars	7 cars	4 cars	2 cars

The figures given for "Straight, Level Road" show the load which may be handled in switching service. The values given under "Maximum Grade" are safe when the grade requires a pull of but five or ten minutes' duration. In any particular case, the number of cars that can be handled may be greater or less than the values above tabulated, depending upon the profile, curves and operating conditions.

*On a fairly level and straight road, the load to be handled is determined by the maximum grade.

The Cleveland, Cincinnati, Chicago & St. Louis proposes to build a new enginehouse this year at Elkhart, Ind., also one at Carey, Ohio, and one at Terre Haute, Ind.

WORK OF RAILWAY TESTING DEPARTMENT.*

By E. P. Tilt, Engineer Tests, C. P. Ry.

Up to the year 1875 there had been constructed in America about 75,000 miles of railway, and this was the year just preceding the introduction of the automatic air brake, when we find the Pennsylvania Railroad establishing what we believe to be the first railway chemical laboratory in America. The man selected to be the head of this department was the late Dr. Charles B. Dudley, who became a world wide known authority on railway materials. His own words written some time after taking the position in November, 1875, show how he, a college trained chemist, and his department were regarded: "So little was the possible use of a chemist appreciated, and so little work was known that he could do, that permission to have a chemist was granted more as a concession and as an experiment than with any faith or belief that the scheme would prove to be permanent or valuable. It is also fair to say that at that time the field for work was as much unknown to the chemist himself as to the railroad officers." Consider the conditions at this time: railways were expanding very fast, much material had to be purchased and the standards of quality desired had largely to be investigated and determined, and suitable specifications drawn up to cover the purchase of these materials. The laboratory staff then consisted of Mr. Dudley and one or two untrained helpers and this grew until today there is a force of over thirty chemists and other assistants, in addition to a staff of about 200 inspectors of various kinds. The laboratories of the Pennsylvania Railroad report that in 1910 there were 35,872 samples of various materials examined in the chemical laboratories on which there were made 121,970 determinations. In the physical testing laboratory 58,193 routine tests were made which included the inspection of the following material: The inspection of 97,759,972 lbs. of bar iron, of which 4,007,049 lbs. were rejected; 840,750 pieces of air brake hose, of which 108,300 were rejected; 3,000,480 lbs. of waste, of which 1,008,275 lbs. were rejected; 33,734,552 lbs. of steel castings, of which 1,161,379 lbs. were rejected; the inspection of 211,453 wheels, of which 2,519 were rejected. We have given these figures as representing the work done by the largest railway testing department that we know of and the figures well serve to give some idea of the quantity of materials required by a big railway, and the rejections prove the necessity of inspection. There is not a trunk line in America today which has not its testing laboratory in greater or less degree and we find by inquiry and estimate that railways are spending from $10,000 to $150,000 per year on their testing departments. One railway informs us that as a result of an investigation made by their testing department they effect a yearly saving of $80,000 in the treatment of cross ties as compared with their previous practice, while the testing department on another road recently got a reduction of $1,500 on a single shipment of telegraph wire which was not up to specification.

The principal economies which are being effected by railway testing departments, outside of the economy which results from the use of good material instead of inferior material, are those relating to the purification of boiler waters, studies on fuel consumption, investigations in connection with rails, tyres, paints and rubber goods. Some testing departments supervise the manufacture of disinfectants, deodorizers, metal polish, fire extinguishers, boiler compound and cutting compound; and one railway company makes all of the freight car paint which it uses. As an indication of the amount of inspection and testing done we may say that there was formed in 1898 in Philadelphia the American Society for Testing Materials, and this has today a membership of about 1,400, made up of engineers of all kinds and the manufacturers of engineering materials, and a five days' session is held each year for the discussion of scientific papers and the drawing up and standardizing of specifications for materials. Next year the International Society for Testing Materials meets in New York, and the engineering professions from every manufacturing country in the world will probably be represented. It is very evident therefore that the testing of railway materials is now on what may be termed a standard practice basis and there is a wealth of literature dealing with the technique of inspection and the qualities desired in the materials used. The time is therefore long since past when the question of whether a railway testing laboratory is a necessity or not, and the fact of such a department existing in every progressive railway organization indicates that it is necessary and must therefore be a paying investment.

The management of the Canadian Pacific Railway had early recognized the value of a railway testing department, and since 1891, when W. Bell Dawson started the first laboratory, with Milton L. Hersey as assistant chemist, there has been a department of some magnitude, greater or less, depending upon what purchases of supplies were being made. Within the last few years there has been a division of the system into Western and Eastern lines, the former of which has had its own chemical laboratory at Winnipeg since 1905, which has specialized in water troubles with much success, in addition to doing the other routine work which comes to a railway chemical laboratory. The work on Eastern lines is done conjointly, by commercial testing companies who do all of the foreign mill inspection; Dr. Milton L. Hersey and associates, of Montreal, who do all of the chemical work; and the testing department with laboratory at Angus shops, who do a portion of the domestic mill inspection, and who take charge of the routine sampling and inspection of materials received at the Angus shops, where are located the locomotive and the car departments and the general stores. The duties of the Angus shops testing department include also the preparation of suitable specifications, the investigation of the failures of materials and the studies of processes or special materials. The testing of devices is handled by the mechanical engineers of the locomotive or the car departments.

In the purchase of materials of such wide variety and origin as are required for our company the question of economical inspection is important and the present organization has been found to be a satisfactory and cheap one. A great deal of our heavy materials are bought in Europe and the United States and the keeping of our own inspectors at these distant points would entail much expense. Otherwise we would inspect the material on receipt at the point where it is to be used, which is certain to be unsatisfactory if the material is not acceptable, and the equipment waiting for it would be held up. This foreign inspection has been well handled by outside inspection companies who work under our instructions and with our specifications, and who guard our interests, whether the material is offered at Sheffield, Essen or Pittsburgh.

Our chemical work is done by Dr. Milton L. Hersey and his associates, whose large staff enables them at any time to rush special work or to take care of any sudden increase in work. The staff, which includes among others, Dr. Milton L. Hersey, who has been chemist for the C. P. R. since the inception of a testing department, Robert Job, formerly chief chemist for the Reading Railroad, and later of the firm of Booth, Garrett & Blair, Philadelphia; Charles R. Hazen, former assistant chemist of the Lake Shore & Michigan Southern, are all available for consultation regarding any matter connected with the railway, and this places at the railway's disposal talent which would not otherwise be available in an ordinary railway organization. In doing all of the chemical work for the mechanical departments at Angus shops, Dr. Hersey is kept in touch with all of the inspection and testing, and in addition makes all the fuel analyses for the fuel department, makes investigations and reports of various kinds for the freight claims department and the express company; makes different analyses

*From a paper read before the Canadian Railway Club.

for the engineering department, examinations of foods and waters for the hotel and dining car department, and assays of ores and varied analyses for the industrial department. A large amount of good work is being done by the chemical department in the treatment of waters for locomotives and stationary boilers and in the selection of the proper boiler compound. This is one of the economies which is hard to show in exact figures, yet we believe that it is a matter of saving hundreds of dollars monthly, for the cost alone of a proprietary compound to replace our present standard boiler compound would be an increased expense to the company of $500 a month. One man is kept constantly on the road to see that the compound is properly used and to keep the chemical laboratory advised of conditions generally on the line.

The staff at Angus shops consists of an engineer of tests and an assistant, who pay particular attention to the special tests and investigations in connection with material, the consideration of specifications and the checking and reporting to the proper officials of the work done by the outside inspection companies. There is a chief wheel inspector, who has an assistant to inspect the daily output of our wheel foundry,. and who has in addition charge of the stocks and of the mixtures for the cupolas of the wheel foundry and the grey iron foundry. He also inspects and reports on all failed cast iron wheels and makes special tests of new materials which are submitted for the use of the foundries. There is a laboratory assistant who has charge of all the physical testing and who is assisted by from six to ten of the best apprentices from the shops in the testing and inspection which is done at Angus. We are at present taking shop apprentices for a period of from four to six months, as assistants in the ordinary physical testing and the inspection of material. In this way our apprentices become familiar with the principal characteristics of the common metals and materials which they may meet in the shops, and thus we hope to make them more interested in their work and inculcate the idea that inferior material must always be looked out for. This gives us a large number of inspectors which can be drawn on as required to suit the varying demands. There are, of course, some disadvantages, one of which is that every new boy must be trained, and about the time that he becomes truly valuable he must be returned to the shops; but on the whole the system is working out very well.

The heavy materials are inspected at the mills, and this includes firebox and flange plates, structural shapes for cars, axles, tyres, automatic couplers, billets, springs and cast iron wheels.

Inspection and testing is done upon receipt at Angus of the following materials: bar iron and steel, chain, steel castings, rubber goods, wire cable, bronze and brass castings, babbitts, solders, waste, boiler tubes, brake beams, paints, oils, soaps, cleaners, fabrics, etc.

The inspection of rails and fastenings, bridges and structural material is at present done by outside companies directly for the engineering department, which gets the records of these tests.

Where locomotives or cars are to be built outside, the purchasing department advises us what portion of the inspection work we are required to take care of, and this is provided for, as well as seeing that the other inspection work is done, and the necessary reports made and checked. The inspection made during the building of locomotives outside is done by inspectors from our own locomotive shop who see as to the compliance with our drawings, pass judgment on the workmanship, fit and finish, and assist us in taking samples and following up the tests which indicate the quality of the materials used. Where cars are built outside, the inspection is made in part by men from our own car shops working in conjunction with an outside inspection company, and we are called on for such additional tests of materials as may be considered necessary. The outside construction companies are of course supplied with our specifications, and purchase materials in accordance with them and the materials are subject not only to inspection by the purchasing company but are often checked by ourselves.

The question of where a railway testing department should fit in or how it should be related to the railway organization is an important one. It seems to us that the logical place to look for this department, which questions the quality of materials offered or purchased for all other departments and which makes reports thereon to the heads of the departments, should be under some general officer. In our case the testing department has been successively under the engineering department, the stores and the general manager, and is now reporting direct to the vice-president's office; and the most satisfactory relations to all have been while under the general manager or the present arrangement. In our opinion then, the testing department should be responsible only to the management, and while reporting to all other departments, should be independent of them, that is, should be a free lance.

The testing department must necessarily stand close to the general storekeeper, advising him promptly when the material is not of the desired grade and suggesting its disposal or its rejection. We make all of our reports on the quality of materials to the storekeeper, with copies of the reports to the heads of the departments for which the material is intended, and it is taken for granted by the shops that if material is given to them by the stores, it is of the proper quality, and that it has had the necessary inspection. We have always taken the viewpoint that we should be distributors of information of general interest, and in the making of our reports, copies are usually sent to the chief officers in other departments, who are indirectly interested. The testing department can also be of much service to the purchasing department, advising them of the merits of samples as compared with what has been previously purchased, and in working out such specifications as will ensure of their securing a reasonably good commercial material, or article for the purpose intended at a fair price. The cost of inspection, outside of the cost of the material which may be destroyed, varies greatly and may be as much as 5 per cent of the value of the material or as little as .2 per cent.

The making of a specification is a very important part of the duties of a testing department, and the perfect specification should secure the best material at the lowest cost; but in reality the usual specification is very much of a compromise. In drawing up a specification the use of the material should first be carefully considered and the attributes necessary to meet the demands of service well studied. It must then be determined what accelerated or laboratory tests will best show the capacity of the material to meet the service required of it. The departments interested must be consulted regarding the size, shape or form in which the material is desired and the stores must say about the shipping and the storage. The specification must then be submitted to the purchasing department, who send it out to the manufacturers and after some modification and changes we have a general compromise which gives us a material which will be considered a run of mill product purchaseable at a reasonable price. We know often that material bought in this way is not the best material of the kind made, but it probably is the best material, price considered.

In the use of specifications, the ideal way is to send them to all manufacturers of that particular line, an open market so to speak, and after quotations are received, buy from the lowest priced firm. While this again is theoretically correct, yet it is impossible to ignore the claims of manufacturing companies situated on a railway line, and others who for equally good reasons must be considered, and while the virtues given to materials bought through influence of that sort are of the kind which the engineer of tests is unable to detect, yet where judgment is used and a careful inspection made, this is no doubt good railway politics. Then, again, the skill, equipment, tradition, pride and other factors all have a bearing on

the quality of material, and it is a fact that materials bought under the same specification from different manufacturers will differ as to absolute quality, though of course the differences are usually of minor importance and are generally those of finish and appearance.

The difficulty of drawing up and enforcing what may seem to be a reasonable specification is well shown in the case of steel tyres. All railways want a tyre which will wear a long time and which will not break. The tyre manufacturer has taken the view that he should not be told what to make, how to make it, and be held responsible for the result, and then in addition be held down to a price which allows a very small, if any, margin of profit. The result of this disagreement has been that there are very few railways in America today, with tyre specifications upon which tyres are purchased; the American Society for Testing Materials has a specification which is more or less used, and the Master Mechanics' Association is at present drawing up a specification which it is hoped will put the manufacture and purchase of steel tyres on the same basis as rails and similar products. Our company has taken care of this particular difficulty by drawing up what we term a Tyre Standard. This shows the physical qualities of the tyres with which we are being supplied and which are being found satisfactory, so that when a new tyre manufacturer wishes to tender, he is given this standard to consider, and if he can supply the material at a fair price he is given an opportunity and his product is carefully watched to see what results it gives in service. We wish to say here that we have found that the manufacturers of tyres take a pride in keeping up the quality and retaining their good reputation in the same manner in which the conservative manufacturers of some years ago did.

Our specification covering merchant shapes of steel is based entirely upon analysis as being the principal consideration, and steels of different carbons are purchased for particular purposes, thus steel of .25 per cent carbon is used for engine and rod bolts, center plate pins and any place where wear is a consideration .60 per cent carbon is used for knuckle pins and .75 per cent carbon for crosshead keys.

A couple of years ago we added a freezing test to our air brake hose specification. We found difficulty in keeping our train line tight in very cold weather due to the hose becoming stiff, and on investigation it was found that there was a great difference in the stiffness of different makes of hose at the some temperature. We decided finally upon a maximum weight necessary to bend the hose through a certain arc at zero, Fahrenheit, and all air hose supplied to us must satisfactorily pass this test. Since then we have been supplied with a hose of greater flexibility at low temperature, and we may say a better hose too than we previously used.

The manufacture of material, such as disinfectants, boiler compounds and so forth, by a testing department or under the supervision of a testing department, is to our mind a question procedure, and while we are at present making a boiler compound, yet we anticipate at an early date purchasing this material to our formula and specification. We believe that a suitable formula and specification will enable the purchasing department to buy any material with greater satisfaction for use than can be given by intermittent manufacture with all its drawbacks due to irregularity of the quality of raw materials, changes in the workmen during the manufacture and other variable factors. We believe that the following definition of a railway given by Mr. Julius Kruttschnitt, of the Harriman Lines, covers the situation, "A railway is a machine designed to manufacture freight and passenger transportation, it makes ton miles and passenger miles." From a limited observation of railway manufacture, we consider that the great majority of railway materials can be purchased outside with greater satisfaction and economy than they can be made, and we may mention such things as bronze, brass, and steel castings.

The management of the iron mixtures for our foundries is one which has effected a very large saving as compared with previous practice. All of our mixtures are carefully calculated from the analyses of the materials entering into the mixtures and the uniformity of the product is an evidence of the value of this. In our wheel foundry the difference between wheels too hard or too soft for use and good wheels is only a few hundredths of a per cent of silicon or manganese so that great care must be exercised in the choice of materials. In the grey iron foundry we produce three different grades of iron, each day from the same cupola; cylinder, machine and a common iron for grate bars and such castings. Every car of pig iron and coke received is analyzed, as is also our limestone and scrap from time to time, in order to check them.

The scrap dock has been a popular direction for many testing departments to turn to to effect economies, and the following are among the principal items considered in a paper recently read before the Central Railway Club by Mr. J. P. Murphy, general storekeeper of the L. S. & M. S. Ry. Knowing how dear economies in scrap material are to the average railway man and appreciating its importance we quote this in full.

"All bolts and iron suitable for making bolts are assorted, straightened, cut to length, threaded and turned into stock for further use.

"Washers are made from old sheet on a punch which is available for the purpose.

"Nuts are sorted to size and retapped.

"Track spikes and bolts fit for further service are returned.

"Tie plates, angle bars and rail braces are sorted out, the plates often repunched to other sizes, rail braces straightened.

"Coupler pockets sheared from couplers by a hydraulic press and reissued.

"Old bridge channels and angles made into angle iron face plates for cars.

"Frog and switch parts dismantled, and good parts assembled for use in manufacture of new frogs and switches at our rail shops.

"Passenger brake shoes unfit for that service sorted and delivered for use on freight cars.

"Brake beams repaired.

"Forgings capable of being worked over sorted.

"Journals bearings relined.

"Air hose refitted and old couplings used.

"Splice hose for work equipment.

"Throttle packing made from scrap hose.

"Union gaskets made from old air hose gaskets.

"In the handling of scrap the same is sorted for mill classification, thus allowing the purchasing agent to obtain better prices for it."

There are undoubtedly many things to be learned and economies to be effected from an investigation and study of materials at the scrap dock, and our locomotive and car departments are watching this very closely. Our investigations into re-using scrap materials have been very limited, but one included the recovery of oil from discarded dope, and without entering into details we may say that this recovery was an economical proposition when nothing was allowed for the scrap value of the dope, but when the reclaiming process was charged with its market value the proposition was non-paying, to say nothing of the trouble which the use of the reclaimed oil made because of its inferior quality. We have heard of washed waste, which no one wished to use, and of recut files which it was difficult to have mechanics give a fair show to, and it is our opinion that if some of these so-called economies are properly investigated, it will be found that if they bear all the charges which should properly be set against them, that the saving is very small.

The inspection of failed material is made together with a representative each from the drafting office and the shops, so that the question of design, and fit or workmanship, can be considered before chemical and microscopic analysis and physi-

cal testing are done. The results of these investigations of failed materials are usually the finding of inferior material, otherwise there follows modifications of design, variation in shop treatment of material or a change in the specifications for the materials used.

We have done a great deal of testing during the last few years of high speed steels, and drills of different designs made from these steels. We have made tests of files and are called upon continually to judge as to the merits of different brands of shovels, handles, lanterns, hose and many other small devices and materials which it is difficult to satisfactorily cover with a specification. Studies are being carried on relating to steel tyres, cast iron wheels, rubber hose of various kinds, and paints with a view to seeing what improvements can be effected which will result in greater economy to our company.

Paints have always been a favorable and a necessary field for the investigation of the railway testing department, and great difficulty is experienced in securing the materials which are specified. No one will question the knowledge which the paint maker has regarding the use of paints and the attributes of the materials which he uses, but the greatest objection which we have found is that the paint manufacturer does not always seem desirous of carrying out the requirements of the specifications which a railway company draws up, and he tenders on, but prefers to supply the materials which are the best in his judgment. We do not wish to be unfair to the paint manufacturing business, but we believe that more sophistry is practised in that branch of the manufacturing business than any other that we know of.

The sampling of materials is a very important and difficult matter and often does not receive the attention which it should. A sample must be representative of the average quality possessed by the material of which it forms a part, so that judgment and care are necessary to prevent a selection of the best or the worst portion of the material that it is desired to sample.

The forms for reports is a most important consideration and is something upon which a great deal may be said for each particular material and condition requires its own treatment. However, we shall not elaborate on something which is not of general interest, though we may say that we make all ordinary reports in letter form as we think they receive more attention and consideration.

Before closing we wish to say a few words about the supply men whom we have come in contact with, and we may tell you that in all the reports made either for or against materials we have not found any who were not willing to believe that the work had been done impartially and who were not ready to give our work reasonable consideration.

We are sure that we have only touched on the question of a railway testing department in this paper, but if we have stimulated some little additional interest in that work or have called attention to work which has hitherto passed unnoticed we feel that our effort has not been in vain.

STEEL BINS IN CABINET FORM.

A steel storage bin is now being marketed which is intended for manufacturing plant, jobbing house, or wherever small appliances and parts are carried in bulk, such as machine parts, valves, nails, nuts, bolts, screws, pipe elbows, unions and similar articles. The bins are made in the form a large cabinet, and the sizes of the bins are adjustable to varying needs;

They are made entirely of steel, the shelving being so arranged that articles varying widely in size can be stored, by making the compartments small or large. This is done by adjusting the partitions, which are easily inserted and bolted in place.

The design of the bin is somewhat similar to the ordinary egg crate. It is made up of a continuous center partition or back, the full length of the bin. This is tied into uprights placed at right angles, by stove bolts through angles turned on the uprights. This center partition, which is a back for a single face bin, serves as a center or dividing back partition for a double face bin. The uprights at right angles to the center partition or back carry a part of the shelf load, the shelves being attached to them at the front and back by stove bolts.

The bottom shelves tie the construction together at the bottom while the top ledge ties it together at the top. The intermediate shelves are bolted to the uprights and center dividing partitions, tieing the whole together by means of stove bolts which may be easily removed or respaced.

Flat pieces of steel form the back and dividing partitions, upright and horizontal. Stove bolts through the angles made the entire bin secure and permit of adjustment. The shelves are held at the front by shelf supports when it is desired to use the shelf as a bin, to prevent small material from falling out. When it is desired to use it simply as a shelf, the shelf of steel is supported by a hanger.

The bin section can be erected with ordinary labor, the only tool necessary being a screw to tighten up the stove bolts. When erected the bins are tied together on every side and when loaded demonstrate their ability to carry very heavy loads.

Tests have been made to prove the strength and utility of the bins. One test was the placing of heavy loads in the various compartments of a section, slabs of spelter being used, averaging 63 pounds each. The bins were each loaded with from 819 to 1,827 pounds. The total weight of the spleter in the bin section was 15,220, more than 7½ tons —and there was no apparent deflection at any point.

Personals

F. K. Allen succeeds W. G. Weber as purchasing agent of the Algoma Central & Hudson Bay. Office at Sault Ste. Marie, Ont.

E. H. Beard has been appointed master mechanic of the Arkansas & Gulf at Laark, La.

W. F. Harris has been appointed general foreman of the Baltimore & Ohio Southwestern at Cincinnati, succeeding W. H. Keller, transferred to Flora, Ill.

A. T. Shortt succeeds R. A. Pyne as master mechanic of the Alberta division of the Canadian Pacific with office at Calgary, Alb.

P. C. Linck is now general foreman of the Chicago & Eastern Illinois, at Danville, Ill. He succeeds W. D. Smith.

S. C. Kennedy succeeds J. F. Donellan as locomotive foreman of the Great Western at Clarion, Ia.

J. W. Senger has been appointed master car builder of the Lake Shore & Michigan Southern at Chicago, to succeed T. H. Goodnow, resigned. F. H. Hanson succeeds Mr. Senger as supervisor of material, locomotive and car departments with office at Cleveland, O.

F. K. Murphy is now master mechanic of the middle division of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Shelby St., Indianapolis. He succeeds J. A. Gibson, P. J. Hickey and F. M. Lawler. D. J. Mullen is master mechanic of the western division with office at Mattoon, Ill. W. K. High has retired and Mr. Mullen's division now includes the old Cairo and St. Louis divisions.

D. O'Leary is master mechanic of the Columbia & Puget Sound with headquarters at Seattle, Wash.

J. H. Shull succeeds Milton Yetter as president of the Delaware Valley, with office at Stroudsburg, Pa.

O. W. Hitt has been appointed general foreman of the Detroit, Toledo & Ironton, with office at Jackson, O. He succeeds T. J. Price.

J. S. Pyeatt, formerly division superintendent of the St. Louis & San Francisco, has been appointed vice president and general manager of the Ft. Worth & Rio Grande and the St. Louis, San Francisco & Texas, vice W. B. Drake, resigned. His office is at Ft. Worth, Texas. A. A. Graham succeeds C. E. Boss as master mechanic of these two roads with office at Sherman, Texas. Mr. Boss has been appointed master mechanic of the Texas & Pacific at Big Springs, Tex., vice J. Pottor, resigned.

J. C. Benson succeeds J. L. Miller as master mechanic of the Great Northern with office at Grand Forks, N. D. P. S. Markley has been appointed car foreman at Fargo, N. D., vice P. Cebula.

Jas. Ashworth, master mechanic of the Louisville & Nashville, has had his office moved from Birmingham to Boyles, Ala., where new shops have been opened.

The Minneapolis & St. Louis R. R. has absorbed the Iowa Central, which is now known as the eastern division of the former road. C. E. Gossett continues as general master mechanic with jurisdiction over the whole system. His office remains at Minneapolis.

W. C. Lambert suceeds J. P. Worthley as district foreman of the Oregon Short Line, with office at Montpelier, Ida.

E. A. Kelley has been appointed general manager of the New Orleans Terminal Co., vice R. B. Fowler, resigned.

C. K. Shelby has been appointed master mechanic of the Pennsylvania at Olean, N. Y. W. J. Rusling succeeds Mr. Shelby as master mechanic of the Northern Central at Elmira, N. Y.

Page Harris has been appointed superintendent of transportation of the Texas & Pacific with office at Dallas, Tex. The transportation department has been made an independent department and all matters pertaining to it will be under the direct supervision of Mr. Harris.

John D. Isaacs, consulting engineer of the Southern and Union Pacific, has had his headquarters moved from Chicago to New York.

Jesse G. June succeeds J. M. Barrett as superintendent of terminals of the Erie, with office at Jersey City, N. J.

T. N. Russell has been appointed superintendent of the car department of the Cincinnati, Hamilton & Dayton, with office at Cincinnati, O.

Stewart Lee has been appointed superintendent of the Thousand Islands Ry., to succeed P. B. Whiteley, with office at Cananoque, Ont.

V. M. Robinson has been appointed general foreman car department of the Trinity & Brazos Valley. His office is at Teague, Texas.

J. T. Wallis has been appointed general superintendent of motive power of the Pennsylvania, with headquarters at Altoona, Va.

W. A. Reddie has been appointed road foreman of engines of the Vandalia, with office at Indianapolis, Ind. He succeeds J. Q. Mowry, who has been transferred to Terre Haute, Ind., vice J. M. Lindley.

The Bakersfield & Ventura R. R. is now known as the Ventura County Ry.

Fred M. Baumgardener has been appointed master mechanic of the Springfield division of the Illinois Central R. R., with headquarters at Clinton, Ill., effective February 1, vice Louis E. Hassman, resigned to accept service with another company.

T. H. Goodnow has been appointed general superintendent of the Armour Car Lines, with office at the Union Stock Yards, Chicago. He succeeds W. E. Sharp, who recently joined the forces of the Grip Nut Co. Mr. Goodnow began railroad work in 1890 in the locomotive department of the Norwalk, O., shop, of the Lake Shore & Michigan Southern. He remained continuously with that company in various positions until August, 1906. At that time he was appointed master car builder in charge of the Michigan Southern division, also the Chicago, Indiana & Southern and the Indiana Harbor, which position he held until January 15, 1912, when he received his present appointment. Mr. Goodnow is vice-president of the Western Railway Club.

D. J. Mullen.

T. H. Goodnow.

C. M. Hitch.

Major Charles Hine has been elected vice-president and general manager of the Arizona Eastern and the Southern Pacific R. R. of Mexico. Major Hine graduated from West Point and later from the Cincinnati Law School where he was admitted to the bar. He served the Big Four in a number of capacities from freight brakeman to trainmaster, and left this road to serve in the Spanish war as a major of the volunteers. Since the close of that war he has done special railroad work of an advisory capacity in various parts of the country and is best known as the originator of the Hine system of organization which is modeled on the army plan. This system is being used very extensively on the Harriman lines and has just been established on the Georgia & Florida. Major Hine's railroad career has been unique, diversified and successful.

C. M. Hitch.

C. M. Hitch, general car foreman of the Cincinnati, Hamilton and Dayton R. R., at Cincinnati, Ohio, has been promoted to the position of general car foreman of that company's shops at Lima, Ohio.

Mr. Hitch commenced work in the car department of the old Kentucky Central R. R., now a part of the Louisville and Nash-

ville, in 1885. He left that road to take service with the Chesapeake and Ohio in 1889, as car repairer and inspector, and was promoted to foreman of the passenger car department in 1891, which position he held until 1894, when he resigned to accept a similar position with the Cincinnati, Hamilton and Dayton. May first, 1904, he was made general car foreman at Cincinnati, holding that position until January 10th, 1912, when he was promoted to general car foreman of the general shops at Lima, Ohio. Mr. Hitch is a member of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, and secretary of the Cincinnati Car Foremen's Association. He leaves a host of warm personal friends at Cincinnati, who wish him success in his new field of labor.

OBITUARY.

W. F. Buck.

W. F. Buck, superintendent of motive power of the Atchison, Topeka & Santa Fe Ry. at Chicago, Ill., died January 31 from acute tonsilitis. Mr. Buck's death occurred on a special train on which he was being rushed from Albuquerque, N. M., to Los Angeles for treatment. He entered railway service as a machinist with the Northern Pacific Ry. and from 1893 to 1895 he was shop foreman of the same road. From 1895 to 1899 he was general foreman of shops at Missoula, Mont.; 1899 to 1902 general foreman of shops at Helena, Mont.; 1902 to February, 1904, master mechanic of the Rocky mountain division of the same road at Missoula, Mont. In February, 1904, Mr. Buck severed his connection with the Canadian Pacific to become master mechanic of the Arizona division of the Atchison, Topeka & Santa Fe Ry. Coast Lines at Needles, Cal., finally becoming superintendent of motive power of the entire Santa Fe system.

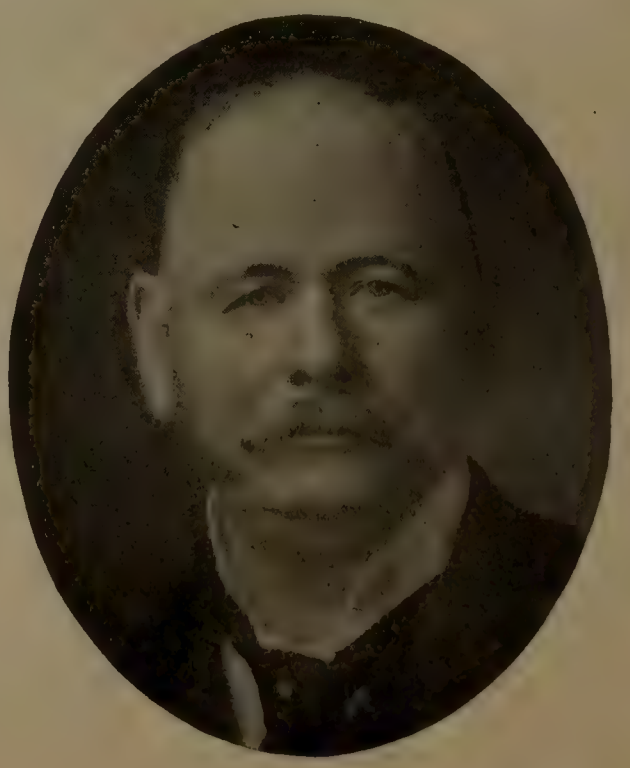
Edwin Hawley.

Edwin Hawley, vice-president of the Chicago & Alton R. R. and the Toledo, St. Louis & Western R. R. and chairman of the board of directors of the Minneapolis & St. Louis R. R., the Iowa Central R. R., and the Missouri, Kansas & Texas Ry., died early Thursday morning, February 1, at his home in New York City. Heart failure was the immediate cause of his death. Mr. Hawley was recognized as one of the foremost railroad men in the United States. He was born in 1850 at Chatham, Columbia county, N. Y., and entered railway service as a clerk with the Erie R. R. in June, 1867. He was employed in various minor capacities by the Ohio & Mississippi R. R., the Chicago, Rock Island & Pacific Ry. and the California Fast Freight Line. In 1883 he was appointed general eastern agent of the Galveston, Harrisburg & San Antonio Ry. and the Southern Pacific Co., and two years later was made general eastern agent also of Morgan's Louisiana & Texas R. R. & Steamship Co., Louisiana Western R. R., Houston & Texas Central R. R., Texas & New Orleans R. R. and the Mexican International R. R. In March, 1890, after the amalgamation of these properties he was appointed assistant general traffic manager of the Southern Pacific Co., at New York, which position he resigned in 1902. In October, 1894, after the reorganization of the Minneapolis & St. Louis R. R., Mr. Hawley was made vice-president and in October, 1906, he became president of that road. By the purchase of a controlling interest in the Iowa Central R. R. he became president of that road also in June, 1900, which titles he held up until a recent date. Mr. Hawley was a senior member of the firm of Hawley & Davis, of New York, and was a director in a large number of banks, traction companies and other concerns. Among the railroads in which Mr. Hawley had heavy interests were the Chicago & Alton, the Des Moines & Fort Dodge, Norfolk & Western, Southern Pacific, Iowa Central, Chesapeake & Ohio Minneapolis & St. Louis, Colorado & Southern and the Western Pacific. He was also a director in the Colorado Fuel & Iron Co., the American Exchange National Bank, the Guaranty Trust Co., the Cromwell Steamship Line and the Pacific Mail Co.

RAILWAY OFFICIALS KILLED IN COLLISION.

James T. Harahan, until recently president of the Illinois Central; Frank O. Melcher, second vice-president of the Chicago, Rock Island & Pacific; E. B. Pierce, general solicitor of the Chicago, Rock Island & Pacific; and E. E. Wright, assistant counsel of the Chicago, Rock Island & Pacific, were killed January 22 in a rear-end collision of two Illinois Central trains at Kinmundy, Ill. The party was riding in Mr. Melcher's private car at the rear of train No. 25, southbound, when it was struck, while taking water at Kinmundy, by train No. 3, also southbound. The private car, which was of wooden construction, was almost completely demolished, but the damage to the rest of the train and passengers was slight.

Other occupants of the private car, Byram Curry, secretary to Mr. Melcher; Thomas B. Busbee, attorney for the Rock Island, and two colored servants, were uninjured. The schedule of the two trains is only about 30 minutes apart at this point, but the foremost train was about 30 minutes late. A public hearing to place the blame for the disaster, conducted by the Illinois Central at Champaign, Ill., found the conductor and flagman of the foremost train, No. 25,



J. T. Harahan.

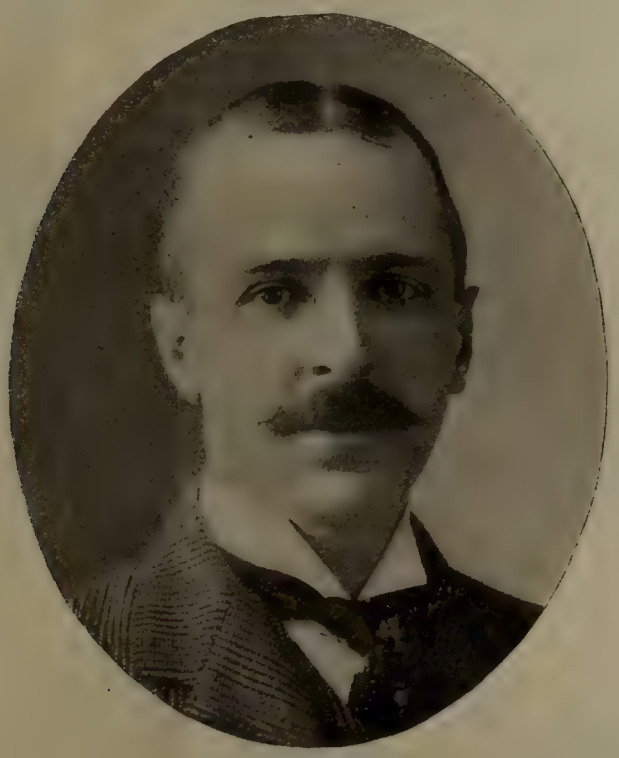
guilty of negligence in not flagging back or using fusees properly, and the engineer of train No. 3 guilty of nelience in failing to see the tail lights of the train ahead and in failing to observe a caution signal displayed by a tower operator.

James T. Harahan.

Mr. James T. Harahan was born in Lowell, Mass., Jan. 12, 1841. He entered railroad service in 1864 at Alexandria, Va., subsequently becoming a switchman on the Orange & Alexandria R. R. During the fall of 1865 and to the summer of 1866 he was in the employ of the Nashville & Decatur R. R. at Nashville, Tenn., after which, from 1866 to 1870, he was in the service of the Louisville & Nashville R. R. in various capacities. From 1870 until August, 1872, Mr. Harahan was in charge of the Shelby R. R., following which until 1879 he was roadmaster of the Nashville & Decatur R. R. He then became superintendent of the Memphis line of the Louisville & Nashville R. R., which position he held until 1881. Subsequently, until December, 1883, he acted as superintendent of the New Orleans division of the Louisville & Nashville and on January 1, 1884, became general superintendent of the same road with jurisdiction south of Decatur, Ill. On July 1, 1884, he was appointed general manager of the entire line, remaining in this capacity, however, only six months, following which, until April 1, 1885, he was general superintendent of the Pittsburgh division of the Baltimore & Ohio R. R. He then re-entered the service of the Louisville & Nashville as assistant general manager, later becoming general manager of the road. From October, 1888, until November, 1890, Mr. Harahan was successively assistant general manager of the Lake Shore & Michigan Southern Ry., general manager of the Chesapeake & Ohio Ry. and general manager of the Louisville, New Orleans & Texas Ry. On November 1, 1890, he went to the Illinois Central R. R. as second vice-president, becoming president of this company in November, 1906, continuing in that position until January 12, 1911, when he was succeeded by Mr. Charles H. Markham, the present president of the Illinois Central.

Frank Otis Melcher.

Frank Otis Melcher was born June 14, 1864, at Damariscotta, Me. He was graduated from Tufts College in 1887 and received a C. E. degree in 1895. He entered railway



F. O. Melcher.

service in 1887 as instrument man on the Fitchburg R. R. He was gradually promoted to assistant engineer, chief engineer, division superintendent and general superintendent, and on July 1, 1890, became division superintendent of the Fitchburg division of the Boston & Maine R. R. He resigned this position on November 1, 1902, to become superintendent of the Illinois division of the Chicago, Rock Island & Pacific Ry. On February 15, 1904, he became general superintendent of the Choctaw district of the same road, later becoming general manager of the Central and Northern districts and subsequently becoming second vice-president of the road, which position he held at the time of his death.

Edward B. Peirce was born at Kosciusko, Miss., August 14, 1868. Mr. Peirce took his degree in law at the University of Mississippi in 1889. He practiced law at Van Buren, Ark., where he was attorney for a number of railroad lines. He became general solicitor and attorney for Arkansas for the Choctaw, Oklahoma & Gulf R. R., remaining in the service of this road until March 4, 1904, when he became attorney for Arkansas for the Chicago, Rock Island & Pacific Ry. Mr. Peirce had been general solicitor for the Rock Island since December 1, 1909, making his home in Highland Park, a suburb of Chicago.

Eldridge E. Wright was a prominent lawyer in Memphis, besides holding the office of attorney for Tennessee for the Rock Island. He was a son of General Luke E. Wright, former Secretary of War, and was a part owner of the *Memphis Commercial Appeal.*

New Books

THE WALSCHAERT LOCOMOTIVE VALVE GEAR. By W. W. Wood, 245 pages, cloth, 5 x 7¼; published by the Norman W. Henley Publishing Co., 132 Nassau St., New York. Price $1.50.

This book is divided into four divisions as follows: Analysis of the Walschaert Valve Gear, Designing and Erecting the Walschaert Valve Gear, Advantages of the Walschaert Valve Gear, Questions and Answers Relating to the Walschaert Valve Gear, Setting Valves with the Walschaert Valve Gear. While primarily the work is a treatise on the Walschaert motion, it embraces the other types of outside radial gears which have been adopted to considerable extent as improvements. Its purpose is to assist in the education of those who already are familiar with general locomotive practice, and to instruct them in the erecting, repairing and setting of radial gears. To this end numerous diagrams have been included in the form of folded inserts and a list of important questions with answers follows the description of each type of gear. The book seems to be best adapted to the needs of the roundhouse and shop man who finds it necessary to thoroughly inform himself on the subject of the proper handling of locomotives equipped with outside valve motion. It is assumed that the reader has previously acquainted himself with ordinary valve setting.

* * *

THE EARLY MOTIVE POWER OF THE BALTIMORE & OHIO R. R. By J. Snowden Bell, 157 pages, cloth, 6 x 9; published by the Angus Sinclair Co., New York.

Although the Baltimore & Ohio is not the oldest railway in the United States, it did operate the first locomotive, that built by Peter Cooper and placed in service August 28, 1830. An historical review, therefore, of Baltimore & Ohio Locomotives is comprehensive of practically all types of the locomotive used on the railways of this country to date. In a book of this nature, the interest depends considerably upon the illustrations and it must be admitted by all that Mr. Bell has secured and reproduced a very unusual collec-

tion of photographs and drawings. The book is one which should absorbingly interest those concerned with the development of motive power.

* * *

PREVENTION OF RAILROAD ACCIDENTS, By George Bradshaw; 173 pages, paper 4½ x 6½; published by the Norman W. Henley Publishing Co., 132 Nassau St., New York. Price 50 cents.

The author of this work is employed by the New York Central & Hudson River R. R. in special service for the prevention of accidents. For many years he has been constantly engaged in the study of railroad accidents by personal and persistent investigation of the facts. In most cases he has examined the particular machine, equipment, structure or place involved and secured statements from those who could give information as to causes, conditions or consequences. One of the conclusions is that the majority of preventable acidents are due, not to defective material or improper method, but to the human element. This work takes up the human element in a heart to heart talk with employes. It shows them (1) the seriousness of the personal injury problem and that they are the real sufferers from present conditions; and (2) how they themselves are responsible for the personal injury record and how they can improve it.

Considerable of the subject matter was first delivered in an address at various division headquarters to employes of the N. Y. C. & H. R. R. R. Attendance was wholly voluntary, yet so great was the interest aroused that special trains became necessary to accommodate employes who wished to attend and at many of the meetings from 1,500 to 2,500 employes were present.

Among The Manufacturers

A PERMANENT RAILWAY SUPPLY EXHIBIT.

Arrangements have been made and anticipations have been realized to a considerable extent for a comprehensive permanent exhibit of railway supplies, in Chicago. The Karpen building recently built by S. Karpen & Bros., located on Michigan Bvld. is to be used, in so far as several of its floors are concerned, for this purpose.

Not the least important feature of this innovation is its club facilities which are adequate and are for the use of exhibitors. The present arrangement places the exhibits on the twelfth floor and the club rooms on the eleventh. It is proposed to make the exhibition a central headquarters for the display of appliances, used in railway operation, where railway officers may examine samples or models of new devices or improvements.

The floor contains 26,000 sq. ft., exclusive of aisles, devoted to exhibit booths. The space has been divided into 150 booths, and the size of allotments are arranged in accordance with the requirements of exhibitors. A large number of applications for space have already been received, enough to ensure the success of the project, and several booths are in readiness for exhibition.

The entire floor is free of partitions and is well lighted. In addition to the exhibit booths the plan of arrangement includes a secretary's office, a large meeting or directors' room, several smaller committee rooms and a large assembly hall seating 400 persons. This hall will be placed at the disposal of both railway and supply men's organizations for meetings free of charge.

Booth spaces are separated by bronze railings and the management provides each booth with a desk, chairs, and a table, all of mahogany, also a telephone and light. Electricity, steam or water for the operation of models or machinery is also provided, as well as telegraph facilities, public stenographer, etc.

Interior View, Railway Supply Exhibit.

It is the purpose of the management to exercise care in regard to the character of the exhibits admitted. It is believed that the establishment of a permanent exhibition will fulfill an important function, enabling a railway man to inspect in a single visit the principal devices and appliances in which he is interested without the necessity of traveling to several different plants.

Karpen Building.

Extensions of the project will place maintenance of way exhibits exclusively on the second floor leaving the present space for the exclusive use of exhibitors of mechanical department appliances.

BUFFALO STEAM HAMMER.

The Buffalo Foundry & Machine Co. has commenced the manufacture of a new line of steam hammers. The illustration shows a view of the 1,500 pound size.

This hammer has a cylinder 10½ inches in diameter, with a length of stroke of 42 inches. The anvil base is an open

hearth steel casting, having a weight ratio to the weight of the falling parts of approximately twenty to one. The lower die-holder is a hammered steel forging, and is secured to the anvil base by a heavy steel taper key. The frames or columns of the machine are also open hearth steel castings, into the recesses of which are snugly fitted the adjustable V-shaped guides for guiding the hammerhead. These guides have a taper gib between them and the column for taking up the wear. The hammerhead is of ample length and is made of vanadium steel. The piston rod has the piston head forged solid thereon, and is a nickel-chrome-vanadium steel forging with an elastic limit of 85,000 pounds and a tensile strength of 120,000 pounds. This forging was very carefully heated before machining. At the top of the frames are two cross tie-bolts, and also a steel cap plate, the outer end of which is gibbed both to the cylinder and to the frame. The cylinder is very heavily proportioned throughout and strongly ribbed. The valve motion is of the well known balanced piston valve type, with removable sleeve in the piston valve chest. The hammer has expansion or stuffing box joints for the steam and exhaust pipes, and the exhaust pipe is arranged so that no water can remain in the bottom of the cylinder of the hammer. The hammer is supplied with an automatic force-feed oil pump, which forces the oil into the throttle valve chest from the movement of the hammer itself. A new feature is the provision of the by-pass pipe and valve to the throttle valve chest, arranged so that after the throttle valve is closed the by-pass will allow sufficient steam to enter to barely hold the hammerhead at the top of the stroke; or, if desired, a further amount of steam sufficient to keep the hammer operating on very short stroke at the top; or the by-pass can be closed entirely and the hammer allowed to come to rest.

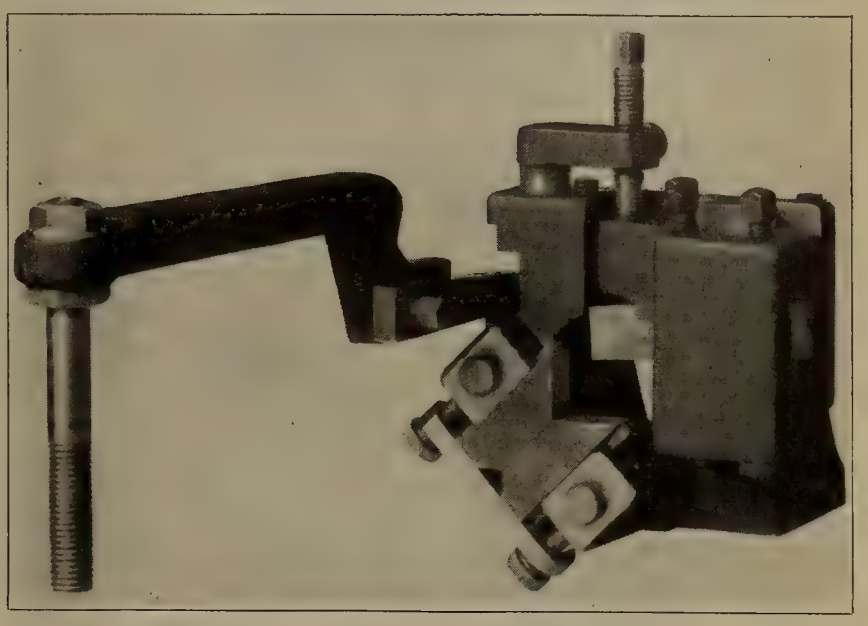
The makers have called particular attention to the strong and secure method of attaching the columns to the baseplate, and also to each other and the cylinder at the top end. The distribution of metal throughout the hammer has been worked out very carefully, so that the machine will stand up to the hard and unusual strains encountered in steam drop hammer work.

Buffalo Steam Hammer.

NEW TAPER TURNING TOOL.

A new taper turning tool in which the taper bar forces the cutter out from the center of the bar, therefore insuring the proper taper, has been brought out by the Acme Machine Tool Company, Cincinnati, Ohio. This is exactly opposite from the ordinary taper turning tool, which depends on a spring to force the tool out against the taper bar, there being nothing to prevent the tool from gouging into the work. It will be noted that the new construction eliminates this trouble.

The pressure of the cut and a small spring holds the tool down firmly against the taper guide. The cutter is mounted



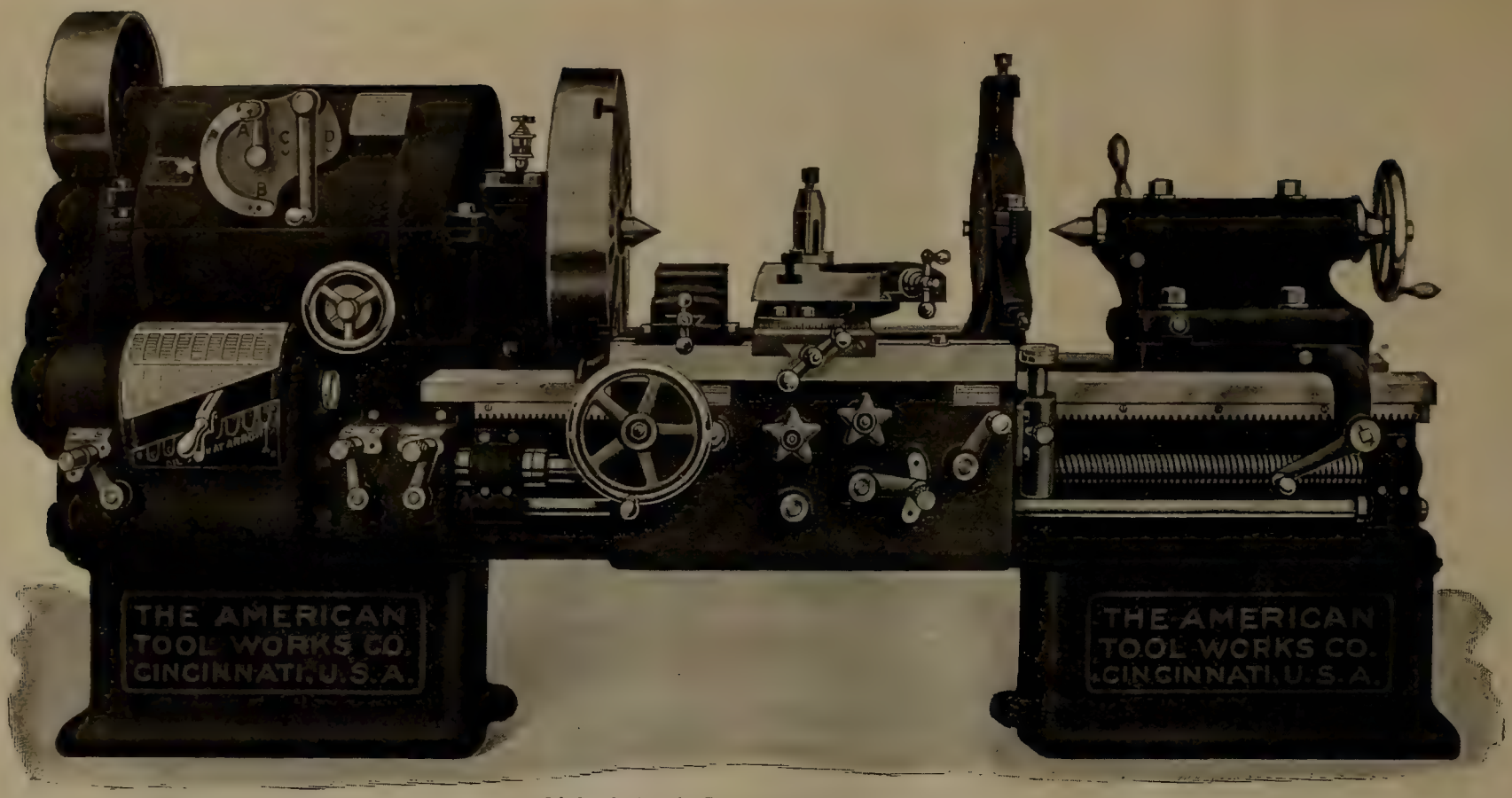
Taper Turning Tool.

in a vertical slide which is connected by means of the long adjusting screw shown, to the "L" shaped piece, to which the taper bar engages. This taper bar is held in position by the bolt shown which is screwed to the head cap of the machine. The back rests precede the tool and work against the straight diameter of the work.

HIGH DUTY LATHE.

A new "American" 24-inch high duty lathe which is distinguished for its capability of transmitting high power has just been put on the market by the American Tool Works Co. of Cincinnati, O. An idea of its strength and power may be gained from the results of a test of the machine, in which it removed 837 pounds of machinery steel in an hour, using but one tool. The patented geared head of this machine affords eight spindle speeds through the medium of twelve gears, two frictions and one jaw clutch. The speeds are produced in geometrical progression and cover a range from 7.3 to 270 R. P. M. All gears are wide face, are cut the coarsest pitch practical with special cutters, are tested for accuracy on a special gear tester, and are mounted on short shafts whih are rigidly supported, thereby eliminating the possibility of vibration.

One of the new features incorporated in this lathe is the thread cutting and feeding mechanism. It is of the cone and tumbler type, embodies only seventeen gears and three levers and produces forty-eight changes for threading and



24-Inch High Duty American Lathe.

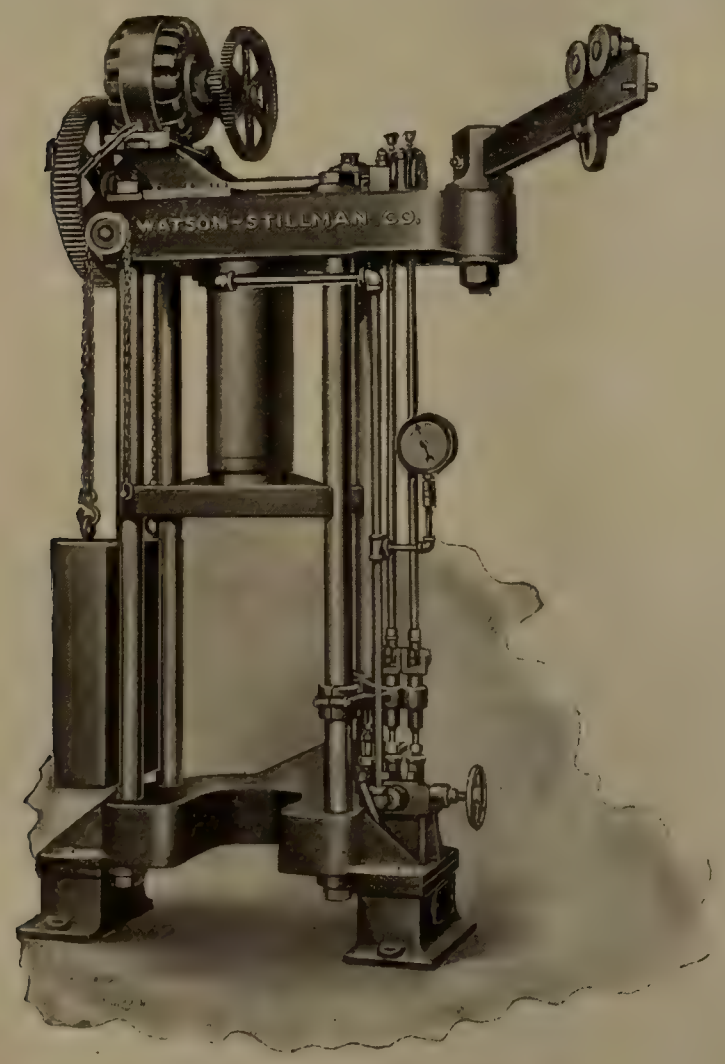
feeding. The cone and tumbler gears are cut from high-grade steel castings with twenty degree involute Brown & Sharpe cutters, which produce a tooth of unusual strength, and one which is pointed at the top.

The advantage of this type of tooth over the 14 degree tooth generally used lies in the fact that the pointed tooth is much more easily engaged, due to its pointed construction and eliminates the riding of the gears on top of one another before dropping into mesh.

A distinguishing feature of this mechanism is the non-speeding up feature which enables the power to be transmitted direct through the cone for cutting the coarse threads and feeds, and thus eliminates the necessity of speeding up by compound gearing to obtain sufficient speed to the lead screw to cut the coarse threads. The advantage of this is that in cutting the coarse threads when the greatest power is required, the drive is direct, and consequently a minimum of power is lost in transmission.

The apron is of double plate construction, which forms an outer support for all studs, including the cross feed stud. All gears in this mechanism are steel and studs are hardened and ground to size. The oiling of the apron has been made a feature, the oil being introduced from the outside and by means of pipes, led to reservoirs formed in the back plate of the apron which contain a large supply of the lubricant. The oil is then fed to the different bearings by means of oil ducts, the oil being filtered and the flow regulated by means of strips of felt placed over the openings of the ducts.

The tailstock is of the four bolt type, the back bolts extending to the top of the barrel while the front bolts extend only a trifle above the base of the tailstock. This construction makes it convenient for the operator when clamping the tailstock to the bed.



Journal Bearing Press.

CONVENIENT HYDRAULIC LOCOMOTIVE BOX PRESS.

The press which is illustrated herewith was designed for F. F. Gaines, superintendent of motive power of the Central of Georgia Ry., and has proven very successful for pressing journal box bearings into and out of place. This press is also useful for broaching, key-seating, putting gears on shafts, pressing bearings, handling mandrels and general railroad shop work where heavy pieces are to be forced together. A crane bracket and beam are extended from one end so that the work may be swung into the press without any hard manual labor. A back-geared motor mounted upon the pedestal on top of the press drives the pump shaft. Upon the other end of this shaft are two pump eccentrics. The pump pistons are both ¾ in. diameter by 2 in. stroke and the pedestal legs act as reservoirs for the pump. The operating valve shown is a single screw stem valve which releases the pressure from the work when open and starts the ram down when closed. A safety valve is used in connection with the pump to stop dangerous overload. The press is made in two sizes, 60 and 100 tons capacity, respectively, and is also furnished hand or belt-driven if desired. This press is built by the Watson-Stillman Co., of 50 Church street, New York.

HOLLOW STAYBOLT IRON.

The increasing interest with which hollow staybolt iron is being regarded by locomotive engineers has received marked stimulus owing to the rule of the federal boiler inspection making a tell-tale hole compulsory in staybolts.

Staybolts produced from hollow charcoal iron make tell-tales on fractured or broken stays, and, furthermore, every hollow rolled stay is said to possess more endurance than that made from the best solid iron. Danger of stoppage, it is claimed, does not exist in the case of Falls Hollow staybolts, as the passage of air currents through the entire stay prevent stoppage, and is a great advantage in combustion.

The following reasons are given by the Falls Hollow Staybolt Co. why hollow staybolt iron should be used in the construction and repair of boilers:

Because it complies with the new federal boiler inspection rule, requiring that all rigid stays have a 3/16 in. hole extending in them from the outer end, and that all solid stays be regularly inspected and condition recorded.

Because the tell-tale hole is rolled throughout the entire length of the hollow staybolt in the process of manufacture, and will therefore indicate a fracture by a slight leak at both ends, instead of at one end, as in the case of the drilled hole.

Because hollow stays do not close up, the suction created by the exhaust of the locomotive tending to keep open the hole in the hollow stays.

Because hollow bolts are automatically inspecting at all times, and are more reliable than any human inspector, as they give warning immediately in case of breakage by a little escaping steam at the end of the stay, while the best boiler inspectors are often deceived by uncertain sound or vibration of the sheet.

Because the hollow rolled staybolt, being specially flexible, possesses great durability.

The staybolts in question are supplied by the Falls Hollow Staybolt Co., of Cuyahoga Falls, Ohio.

ALLEN HAMMER RIVETER.

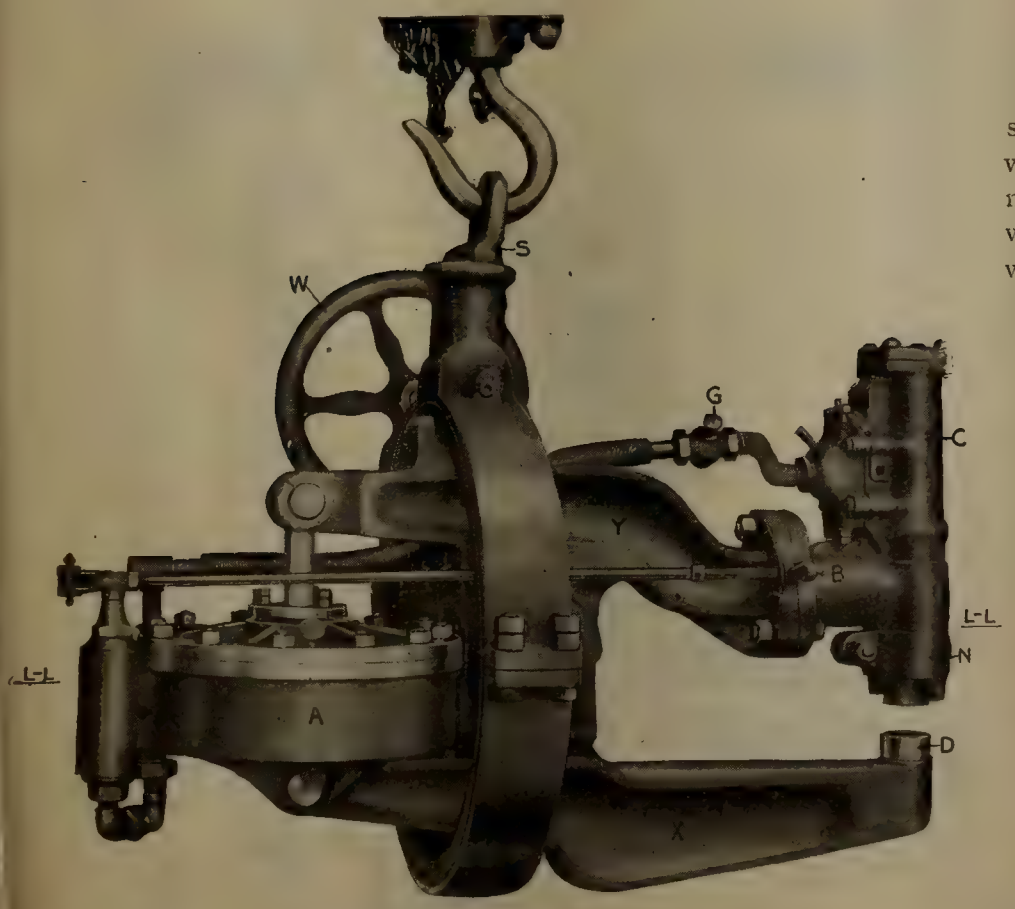
A notable addition to the line of hammer riveters, built by the John F. Allen Company, 370 Gerard Avenue, New York City, is shown in the illustration herewith. This riveter, on account of its shorter reach and lighter weight, is intended for work that is beyond the scope of the regular Allen boiler riveting machines and should have a wide application. Its reach is 15½ ins. and it is sufficiently powerful to drive rivets from ⅜ in. to 1 in. diameter.

In operation the work to be riveted is placed so as to bring the rivet head on die "D" with the free end of the rivet pointing toward the axis hammer cylinder "C." Upon moving handle "B" toward "C" air is admitted to cylinder "A." This closes arms "X" and "Y," and with a pressure of about 4,000 lbs. firmly secures the plates to be riveted between die "D" and nozzle "N."

When button "G" is pressed air is admitted to cylinder "C." This causes the hammer to strike the end of the rivet a series of swift blows, heading the rivet in a few seconds. Upon releasing the pressure upon button "G" the motion of the hammer is arrested. Moving handle "B" toward the rear of the riveter immediately opens arm "X" and "Y" and releases the plates which are moved immediately upon inserting the rivet into position and the riveting operation repeated.

The machine is in balance when suspended from hook "S" and can be swung in any direction. It turns on its long axis "L-L" by means of the handle wheel "W" which operates a worm engaging a worm-wheel enclosed in the supporting "R."

This riveter operates on air at a pressure of from 60 to 100 lbs.



Allen Hammer Riveter.

"ONE-MAN" DRILL.

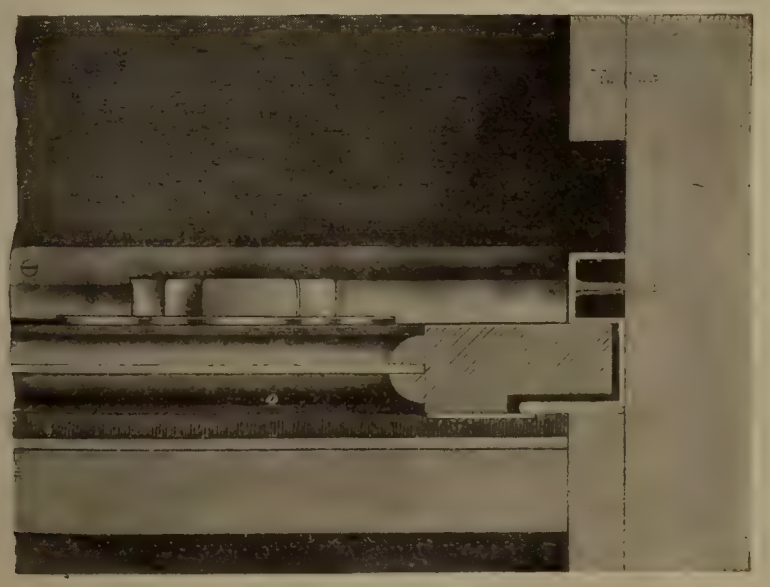
The Independent Pneumatic Tool Company of Chicago, New York, Pittsburgh, San Francisco and Atlanta, has recently placed on the market a new "One-Man" drill equipped with compound planetary gears which is particularly adapted for drilling, tapping and screwing in stay-bolts and studs of all sizes up to 1¼ ins.

Heretofore such work required at least two and sometimes three men to lift and balance a portable machine with sufficient capacity to perform this work, which accounts for the new and appropriate designation of "One-Man" drill.

The drill is of course of the reversible type, weighing but 20 lbs., equipped with No. 3 Morse taper socket, and, like all Thord drills, has Corliss valves with which users are familiar.

ACME WEATHERPROOF WINDOW.

Improvements and new ideas in car windows and window sashes are constantly being brought out, and the Acme weatherproof window shown in the illustrations is one of the most recent and efficient devices of the nature. The motive which is the basis of its construction is that the external wind pressure on a car window should be used to more thor-

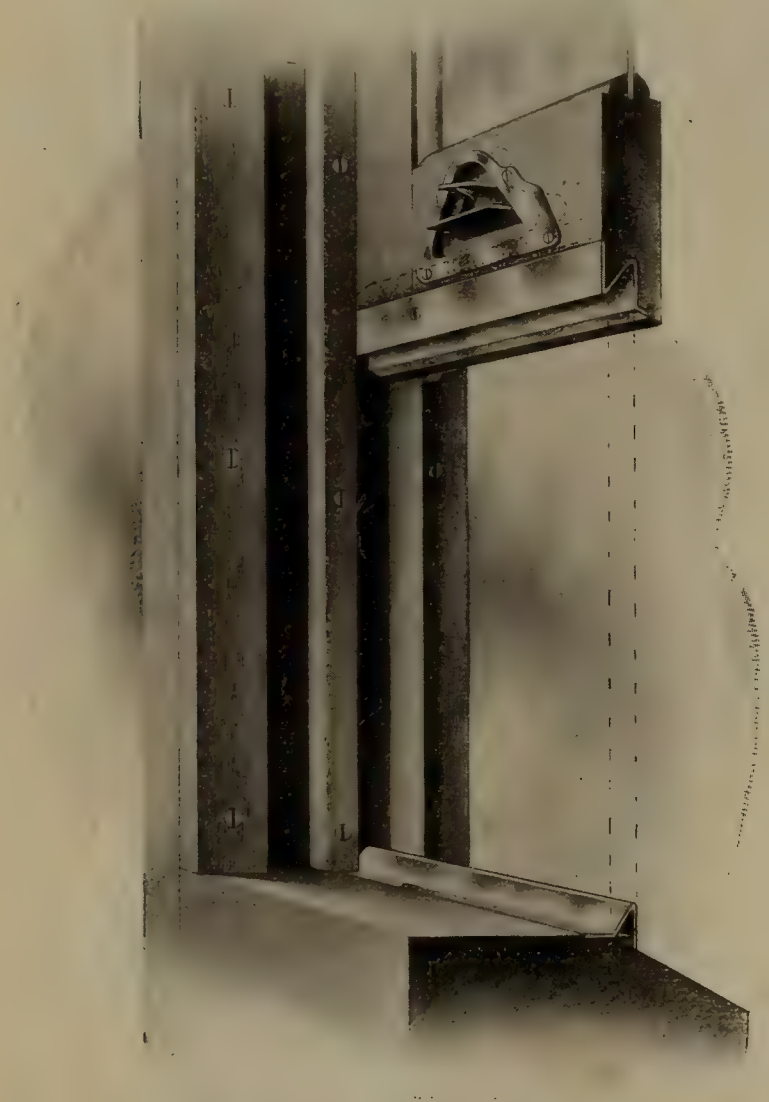


Cross-Section Showing Weatherproofing Features.

oughly seal the joints instead of having the tendency to open them wider. For this reason the weatherproofing features are placed on the inside and are of metal instead of wood. The general details of its construction are easily seen from the illustration. A V-shaped metal strip at the bottom of the sash fits over a similar strip on the sill, and the weight of the sash rests on the sill strip, thus insuring a tight and even joint.

The vertical strips comprise a pair of pressed steel guides which are fitted to the sash before it is placed in the casing. A strip of brass attached to the sash on the outside bears against a lip on the pressed guide, thus making a tight joint. A good contact at this point is always assured because of the fact that the notches for the latch pins are inclined and caused the sash always to be forced into contact with the guide.

An eighth of an inch play is allowed the sash, and as it is

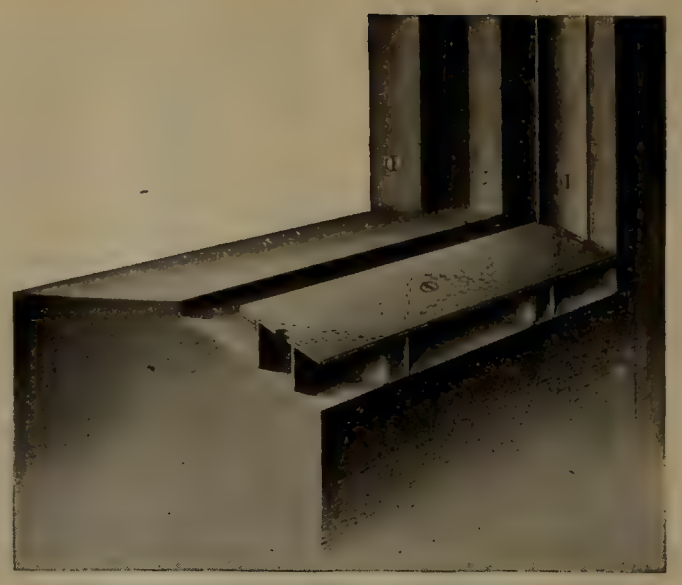


Acme Weatherproof Window.

equipped with two fixed rollers at one side and a spring mounted roller at the other there is ample protection against binding. When the window is closed it is sealed at the top with a strip of plush. It is said that no leakage has been observed through the stops, while being tested with compressed air and with water. Although the illustrations show the strips as applied to new windows, they can easily be applied to old cars without making any changes in the sash, the bottom strip simply being fastened to the surface of the wood.

Another improvement for window sashes is the Acme dust and cinder deflector shown in the accompanying illustration. The movement of the train causes the air to follow the trend of the curved plates, thus causing a vacuum near the base of the sash.

These devices have just been brought out by the Acme Supply Co. of Chicago. Other new products of the above firm are a perfected curtain stop which provides a positive



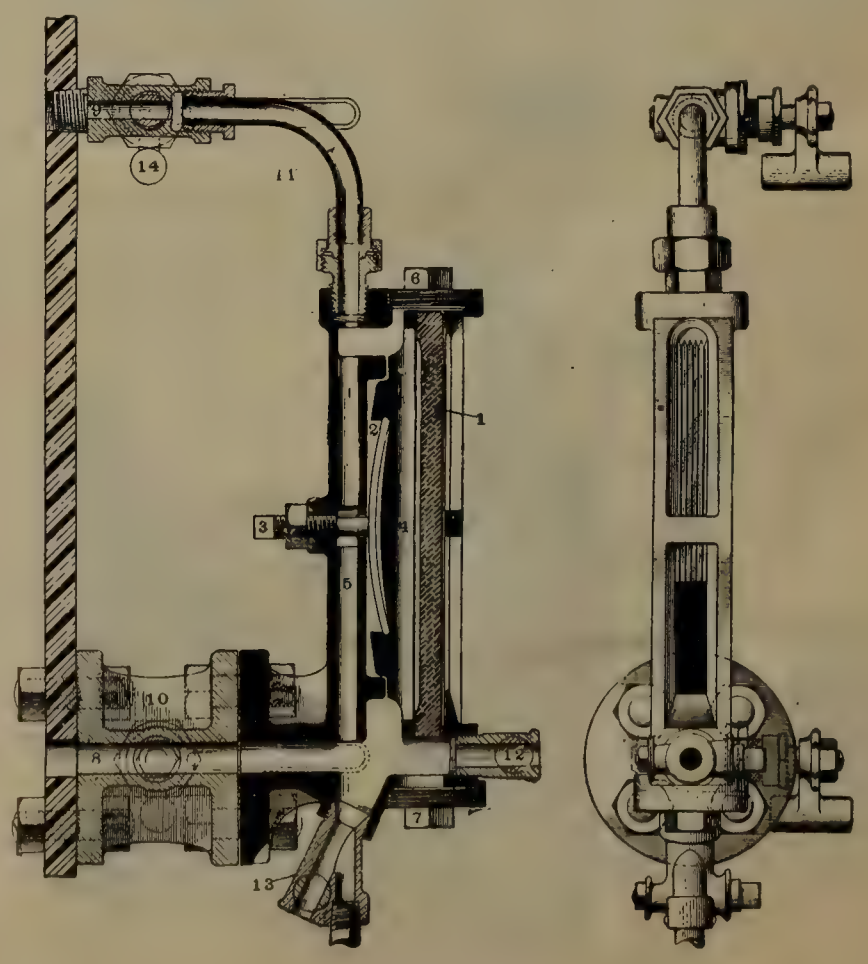
Acme Dust Deflector.

stop for curtains, a new deck sash and fixture, which is weather and dust proof, and several types of pressed steel car doors.

SHROUDED GLASS WATER GAGE.

The accompanying drawing shows the shrouded glass system for locomotive water gages made and sold by the Prince-Groff Co., of Camden, N. J.

The principle of the shrouded glass is well known and its advantages are many. The flexible steam connection, the shroud protected glass, and the separate passageway for steam have overcome breakage, leakage, steam erosions, and the destructions from expansion and contraction, whether caused by heat and cold or high and low pressure. The positive cleaning means (brush) for water connection to the boiler and gage column black background and glass insures reliable readings. False readings from a clogged passageway are thus avoided. The frame is red, the water black, and the steam shines with a silvery luster, making a strong contrast. Low water reading is made possible by bringing the gage down close to the water connection. The extended bevel at the bottom of the sight opening covers up the clear end of the reflex glass and gives a sharp, distinct, disap-



Shrouded Glass Water Gage System.

pearing water column. The large open passageway from which packing is entirely eliminated and the straight way valves are features of merit. The protection rendered the operatives is an additional feature of the Prince-Groff system.

New Literature

Burton W. Mudge & Co. have issued two circulars, the first describing the Garland ventilator for buildings and shops; the second descriptive of the Garland door closing and opening device for refrigerator cars. The building ventilator works on the same principle as Garland car ventilator.

* * *

The T. H. Symington Company of Baltimore, Md., has just issued a new and attractive booklet illustrating and describing the Farlow draft rigging. The written matter is subdivided under three heads, mechanical, transportation and economic. The best method of assembling is illustrated and described for the benefit of car foremen and others interested in the proper application of the draft rigging to the car frame.

* * *

An illustrated folder showing octagonal sectional expanders, roller expanders, flue cutting machines and other boiler tools has been issued by the Faessler Mfg. Co. of Moberly, Mo.

* * *

A paper on "Steel Pipe Versus Wrought Iron Pipe in Refrigerator Work," which was read at a recent meeting of the American Society of Refrigerating Engineers, is republished in Bulletin 5 of the National Tube Co., Pittsburgh, Pa. Bulletin 7 is devoted to the N. T. C. regrinding valve.

* * *

"Insulation of Railway Equipment" is the title of a new book of 125 pages for railroad men interested in refrigerator cars, steel passenger cars, ice houses, railroad hospitals, or the subject of insulation in any way. It is the result of observation, test and study by railroad men, chemists and mechanics, and is issued by the Union Fibre Co., or Winona, Minn.

* * *

Automatic starting control for motor driven machinery is rapidly gaining favor on account of the improper manipulation of hand starters, which often results in considerable damage. The Reliance Electric and Engineering Co. of Cleveland, O., has brought out an automatic starting device which is thoroughly described in Bulletin No. 7010.

* * *

The Armstrong Manufacturing Company, of Bridgeport, Conn., has just issued a new half-tone 6 x 9 catalog showing its full line of pipe threading machines and parts. Each part is either lettered or numbered, so a customer can order repairs to replace broken or worn parts from the catalog and save time, which is very important in case of a break down.

* * *

An excellent catalog of oil filters, exhaust heads and ventilators has been issued by the Burt Mfg. Co. of Akron, O. The reading matter is printed in large readable type and a large number of illustrations are scattered throughout. It is an example of very good catalog work and is worthy of the attention of anyone interested in the above line.

* * *

The Locomotive Equipment Co. of Detroit, Mich., has issued a catalog dealing with the Newcomb journal box. It is said that this box effects a great saving in lubricating oil, waste and journal brasses.

Industrial Notes

The Chain Belt Co. of Milwaukee, Wis., has opened an office in Chicago at 900 Old Colony building, under the charge of Mr. Benjamin S. Reynolds, a member of the engineering staff.

C. A. Delaney, for a number of years superintendent of the Dickson Works of the American Locomotive Co., New York, with offices at Scranton, Pa., later sales representative at that place, has been made western representative, with offices in Chicago.

On February 1 the interests of the Empire Iron & Steel Co. of Niles, O., will be absorbed by the Brier Hill steel Co. of Youngstown, O. The new merger involves several large independent steel interests of the Mahoning valley. Officers will be elected February 1.

William J. Coane, manager of the Philadelphia, Pa., branch of the Joseph Dixon Crucible Company, Jersey City, N. J., and for 25 years with that company, has been made second vice-president and sales manager of the Ajax Metal Co., Philadelphia.

C. R. Jamison, for the past five years connected with the Berger Manufacturing Company, Canton, Ohio, has been made sales manager of the Acme Supply Company, Chicago.

Joseph T. Ryerson & Son, Chicago, have opened a branch office in the Ford building, Detroit, Mich., in charge of J. H. Marlotte.

The American Bridge Co. has received an order from the Texas & Pacific for three 75-foot deck girder turntables, 165 tons.

James B. Brady has been elected vice-president of Manning, Maxwell & Moore, New York, succeeding W. O. Jacquette.

Mr. L. A. Darling, formerly of the R. G. Peters Manufacturing Co., Grand Rapids, Michigan, has affiliated with the Remy Electric Co., Anderson, Indiana, as engineer of the locomotive headlight department.

J. A. Fay & Egan Co. announces that new offices have been opened at 170 Broadway, Suite 1617, New York City.

The Baldwin Locomotive Works, has decided on the Calumet region as the location for its proposed western plant which will employ about 6,000 men. The site is at Indiana Harbor is bounded by Cline and Parrish avenues, Indiana Harbor Belt and Baltimore & Ohio Chicago terminal, comprising 750 acres.

The Grip Nut Company announces the engagement of Mr. D. F. Lillis as Eastern Sales Agent, with headquarters at New York. Mr. Lillis has been in railroad work for about twenty years, filling various positions, including chief clerk to four presidents and general managers of the Lake Shore and Michigan Southern, and later was secretary to Mr. J. F. Deems, general superintendent of motive power and rolling stock of the New York Central Lines.

Mr. A. D. McAdam has been appointed Chicago representative of the Ralston Steel Car Co., of Columbus, O., with offices at 720 People's Gas building.

The Southwestern Iron Works, Guthrie, Okla., has made a contract with the Chicago, Rock Island & Pacific to furnish castings for the next year, the contract being estimated at $150,000.

"On February 1st, the Westinghouse Air Brake and Traction Brake Company moved the office of their southeastern manager, Mr. E. A. Craig from the general office, Wilmerding, Pa., to 308 Westinghouse Bldg., Pittsburgh, Pa.

The Zug Iron & Steel Co. is moving its general offices from 13th and Etna to 14th and Etna Sts., Pittsburgh, Pa.

RAILWAY OPERATING ORGANIZATION.*

By Major Charles Hine.

As a result of the studies undertaken something over three years ago under the direction of Mr. Julius Kruttschnitt, director of maintenance and operation of the Union Pacific System—Southern Pacific Company, there has been progressively inaugurated upon the Harriman Lines within the last three years a system of organization differing from that of other railways. It is intensely divisional, but it is more. Carried to its logical conclusion it reaches down even to the sub units of a division. This system is predicted upon the doctrine that the individual is the indivisible unit of society. We start with the individual and build up from him in groups of varying size, until we reach all of the persons employed in that particular activity. Please keep that in mind, that the individual is the unit.

Following this to its conclusion, we say that if the individual is the indivisible unit his name is his birthright, and that his signature is his patent of enlightened manhood. We say that no man should sign the name of another, primarily, because it is not honest, it attempts to convey the idea that Mr. So and So is in his office when as a matter of fact he is a hundred miles out on the road. Since custom tempers and modifies this condition, I grant you it is not as bad as it seems. Furthermore, it is a violation of the fundamental laws of the matter. It is not scientific to say that a man can be in two places at the same time. You will find the same subtle arguments to bolster up that view, however, that you find used by the learned men of the middle ages in bolstering up the institution of Feudalism. The lawyers and the clergy of that period were very prolific in legal fictions and in the justification of practices which made the feudal laws supreme over the fief or the particular body of land to which adherence belonged.

As stated before, the organization, the financial organization of the country and its corporate organization, in the broader view are largely feudal. We find that same idea projected in the lower ranks. We do not find as yet those checks and balances against the caprice of individuals in authority. We find the tendency to regard this as "my property," "my office" and "my men." Gentlemen, we are not the subjects of a king, or the creatures of a president; we are citizens of the United States. The President, as the chief magistrate, the man clothed with temporary authority, administers the laws of the country under certain checks and balances imposed by the Constitution. So in the conduct of the corporation. We do not belong to the boss. He is responsible in a greater degree than we by reason of his superior rank, but we all who are entrusted with authority are trustees in varying degrees of rank. And remember that rank is an indispensable accompaniment of the exercise of authority. The purest democracies clothe their chosen leaders with temporary rank, which is exercised under prescribed methods.

So in working out a new organization for the Harriman Lines we endeavored to be scientific. All management is scientific, but some are more scientific than others. The man who runs a wheelbarrow has a system; if you watch him all day he does it about the same way; but the great problem is to co-ordinate his system of running that wheelbarrow with the general activity. And you will find that other fact: when we speak of men as unsystematic they are less systematic than others. System is a purely relative term. So in endeavoring to work out a more scientific system we tried to work from these fundamental laws. I am perhaps not exactly fair to state it that way, because sometimes, you know, just as a woman's mind jumps over and by intuition reaches a conclusion and says "because," there are some of these things, I confess, that we went back and found the reasons for afterwards. But the thing is, do they square? That is the point, gentlemen. We tested them by every method we knew how, and we found they do square, that our woman's intuition, if you please, had been correct. The first thing we said was that if it is not honest for one man to sign another man's name, if it is not good administration, if it leads to a feeling of lessened responsibility, why, let us cut it out. And there we were confronted by a great many people who said, "It can't be done." "Why?" "We have always done it the other way, and you cannot run a railroad in this way. Just think, the superintendent will lose in prestige." But with a more or less complete application, for three years we have been doing that very thing. If you should go out and check up you would find numerous departures, but there we would ask you to remember again that we are not perfect, that ideas are greater than men, that principles are immutable, however crude may be their application, and we should ask you to look beyond the particular individuals who might be faltering and not quite measure up as well as you feel you would do and see whether the idea squares with the possibilities of things—with the possibilities, not with the way it may have been done before. These ideas have proved so workable that they are now applied on twenty-seven operating divisions of the Harriman Lines, and it is expected that on January 1 the remaining ten divisions will be reorganized. They are now in effect in six general offices, with four more yet to be reorganized. We hope that by the first of January we will be able to state that all the operating department has been reorganized under the new system.

We no longer defend, we explain, because those to whom we are amenable, the public authorities and the owners of the property, the directors and officers, are satisfied. They are the people to whom we have to make good. Of course if other people adopt these ideas it strengthens our own position, and we are very grateful therefore, but we, the officers of the Harriman Lines, are alone responsible to our superiors and to the public as to what we accomplish. We find, though, human nature is the same, and there is a tendency among visiting statesmen who honor us by coming out to say, "We will try a part of this and not the other, that will be easier." My stock reply is that if you are going to cut off a man's finger you would not make it easier for him by cutting off a piece at a time. If you are not prepared to come up to this don't fool yourself into believing that you can just take a part, because the chances are you will be disappointed in that particular part unless you work it altogether. Then, too, as a sporting proposition, never try to beat a man at his own game until you learn it. Play it his way first. Now, that is what we did. We played the old game as well as we knew how, learned it as thoroughly as we could, and then we started the new game. So we ask you not to pronounce finally upon the merits of this until you have actually played in the game yourself.

Now I will explain the details, assuming that the general outline is more or less familiar to you all.

Beginning at the first step we do this: Taking a division as a typical unit of organization, the first thing to do is to bring the assistant superintendent to the office, put him in charge of the office. If there is no assistant superintendent there should be one appointed, if necessary appointing a train master for his outside duties. Usually in the beginning people said to me, "Here, we can't spare that man. He is the boy that gets out and makes the cars jump over each other. Why, he will raise these blockades. We cannot spare him for the office." I say, "then there are two reasons why he should go in the office. First, he may die some day, and it is high time you broke in an understudy, because the railroad cannot stop running its trains when he

*From an address before the New England Railroad Club.

dies. Second, we want him in the office because we want the railroad atmosphere in the office." When a boy starts to learn the barber's trade he begins in the shop blacking shoes. Why? To get the atmosphere of the business, to learn how to handle gentlemen, how to treat the public, and it may be long time before he is allowed to touch the head or the face. So there is a great deal in atmosphere. When the railroads were small it did not matter so much. Everybody knew everybody else. There was, perhaps, one clerk in the superintendent's office, and that clerk would take out a train if the conductor laid off, and it was a happy family. It worked out very well. And here is a beautiful example of a state of affairs existing by reason, and good reason. There was a reason for all these things when they started them that way, but we feel that that reason has been outgrown and that that conception is not workable with the present magnitude of affairs, because, remember that the average division of today is as large as many railroads of forty years ago. So this man comes in and takes charge of the office. Some of the men who have come in were men of very limited opportunities for education in the beginning, and they have made some mistakes in grammar, but they did not make very many in judgment.

Then the next step; we go over to the shop and pick up the master mechanic and bring him to the superintendent's office. The old theory has been that the master mechanic at the shop supervised his shop forces, which works out admirably for that one shop. The tendency is for the master mechanic either to be in that shop and so active that he dwarfs and unconsciously belittles his general foreman, who becomes a fifth wheel, either that happens or the master mechanic sits in an office near the shop and writes letters to the superintendent and to the superintendent of motive power, assuring them of his distinguished consideration and telling them that the engine could not possibly have failed because they had done all this work on her. Now, we find that when the master mechanic is over in the superintendent's office, why, before he knows it he is going in and looking at the train sheets, to see that the engine goes out in a little bit better shape to make time than she did before. That is largely unconscious on his part. Organization is a branch of a larger science, sociology, which is the science of human nature, and true organization so unites these human elements that we get the maximum effort of the man whether consciously or unconsciously. We hear less and less about "my department," and more and more about "this division" and "the company."

Having already at headquarters the division engineer, the train master and the chief dispatcher, we consolidate the files of all these gentlemen and dispense with that beautiful custom which was in vogue when I was a chief clerk to the superintendent, by which I dictated a letter and signed the superintentdent's name, to the division engineer in the next room, and then he dictated a letter and signed his superior's name, and it came back to me and I incorporated the substance of that in a third, signed the superintendent's name and sent it to higher authority, both of our bosses being out on the road all the time and entirely ignorant as to the particular details of that transaction. We don't do that any more. We say that this is all the superintendent's office, that, because it is all the superintendent's office, if a paper happens to be in a particular room and on the desk of the old division engineer it is in the superintendent's office. We have one consolidated file for all of these gentlemen. Normally the superintendent does not write to one of these staff officers any more than he writes to his own chief clerk.

With all our mania for records and for building up a file against the other fellow, you don't find a man building up a file against his own chief clerk. Why should he build one up against his own division engineer or his own train master? We borrowed that idea from the civil courts. You may find in the court of a large city a dozen judges on the bench, and you find perhaps in many of the States they rotate those judges from the probate court to the criminal court, or some other court perhaps. It varies in different parts of the country. But you find one office of record, under a clerk of court, with as many deputies as may be necessary. When a judge wishes to know what another judge has done he does not write that judge a letter and ask him, and start a file back and forth, he sends to the clerk's office and gets the record in the case.

For over three years the office of Mr. Kruttschnitt, who has the largest operating jurisdiction in the world I am told, some 18,000 miles of railroad, employing from 80,000 to 100,000 men, earning in round numbers something like $225,000,000 gross per year, has been handled with a consolidated file. Gentlemen, if that can be done it is idle to say that "our division" is so peculiar and "our local conditions" are so different that we cannot do it. We have not found a division yet where it will not work.

Having consolidated those files we then change the titles of the whole blooming bunch to assistant superintendent. Usually we take all these steps at once. When we get ready perhaps we do the whole thing at once, have a grand moving and get it over with.

Then we give to the division three principles in the nature of a constitution. First, no man shall sign another man's name; second, there must be an official in charge of the office, which is railroading right through. We say to a conductor on the way freight, "You have two, three, four, five brakemen. Assign them on the train wherever you see fit, except you must have a flagman on the rear car." We say to the superintendent, "Put these assistants wherever you see fit, but you must have a flagman in your office." Just straight railroading, you see! That is the second principle.

The third principle is that normally communications shall be addressed impersonally. That is based upon the principle that authority is abstract and impersonal. The court exists if the judge is dead. The governor's position exists if the governor is dead. The exercise of authority, however, is very concrete and highly personal. The court is silent until the judge speaks. The office of governor is inert until the governor acts. So here again we are up against straight railroading. A conductor comes to the office and reports for orders. It is none of his business what dispatcher is on the second trick or on the third trick; he has a right to know that a competent person is on duty and is not drunk or crazy, but he cannot dictate as to who that person shall be. He takes the order and runs on the last orders he gets. Now, we carry that a step further, and we say that it is none of the conductor's business normally who will handle a letter he sends in, so we ask him to address his letter assistant superintendent. Under the system as I shall explain, some assistant superintendent will handle it. A a matter of common sense and good administration, if that report or letter is about a broken wheel we are going to have the old master mechanic, if we possible can, handle, it, because it is a technical matter in which he is our expert. And there in the beginning we struck the greatest objection. The master mechanic said, "This is a technical matter. I don't believe in anybody else handling that; it is technical." "Suppose you were out on the road, who would handle it?" "My chief clerk." "Is he a technical man?" No, but he has been with me a great many years, he understands about these things." Right there we say that rather then have that handled by a chief clerk we would have it handled by one of the other officers, perhaps the old train master.

(To be continued.)

Recent Railway Mechanical Patents

CAR TRUCK.

1,014,807—Samuel P. Bush, assignor to the Buckeye Steel Castings Co., Columbus, O.

1. This car truck frame consists of compression and tension members and two jaws at each end, all cast integral, the, lower jaws each being provided with an upwardly projecting lug, adapted to yield or give vertically, whereby each journal box may be entered side-wise between its jaws and over the lug, and when in place be held against lateral displacement by the lug on the yielding lower jaw.

ELECTRIC LOCOMOTIVE.

1,014,825—Fred B. Howell, assignor to the General Electric Co., New York.

This patent relates to an electric locomotive comprising a frame, driving wheels and axles, a transverse jackshaft between the axles, a gear wheel on each end of the jack-shaft, crankpins on the wheels and gears, and side rods connecting the crank-pins. Two electric motors are supported above the jack-shaft and between it and the driving axles, the motors having armature shaft-extending across the locomotive, and a pinion on each end of each armature shaft, the pinions on each side of the locomotive both meshing with the gear wheel on that side.

CAR TRUCK.

1,015,152—John DuRoth, Johnstown, Pa.

A car truck embodying two sets of side frames, journal boxes supported by the ends of frames, wheels arranged between the journal boxes, oppositely disposed stub axles carried by the wheels and extending into the journal boxes. Transverse beams connect the side frames, corner straps connect the inner frames with the transverse beams. Cushioning device connected by transverse beams are carried by each set of frames, the car bearing is supported centrally of the transverse beams and a yoke connects the cushioning devices.

JOURNAL BOX.

1,015,152—Michael P. Newcomb, Sandpoint, Idaho.

The combination with a journal box having a threaded opening, of a cap mounted in the opening provided with an inwardly projecting sleeve, having an internally threaded portion. A threaded shank is provided with an abutting head mounted within the sleeve portion and extending out through the cap, the shank being provided with an internally threaded portion, and a bolt adapted to thread in the threaded portion of the shank.

CAR ROOF.

1,015,340—Edward Sosson, Chicago, Ill.

A car roof comprising a supporting framework, metal sheets laid thereon side by side, means to hold the sheets approximately in place but permitting slight adjustment thereof relatively to each other and to the framework. The securing devices comprise clips each having one end fastened between the side wall of the bar and the fascia and the other end reaching up over the lateral edge of the roof sheets.

CAR DOOR.

1,015,387—Belden D. Jones, Chicago, Ill.

The combination with a car body having a car door opening, of a door mounted to move across the opening, a door post at either end of the opening, a door stop at one end thereof, and a weather guard comprising an angle iron secured to the door at its end remote from the stop. One flange of the angle iron extends across the vertical edge of the door but is spaced away from the latter to form a vertical channel.

CAR DOOR.

1,015,405—Charles A. Shroyer, Oak Park, Ill.

The patent relates to a car having a rabbeted door opening, a door, a lower guide track extending from one side of the door opening along the side of the car, a shoe secured to the lower corner of the door, and outer and inner depending lips upon the shoe adapted to engage the outer and inner sides, respectively, of the guide-rack. The outer and inner lips are off-set in the direction of the width of the door, the lower edge of the inner lip being adapted to rest upon the lower edge of the rabbeted door opening and to support the door in such manner that when the door is closed the outer lip will disengage the guide-track while the inner lip still lies behind the same.

LOCOMOTIVE BOILER.

1,015,501—William McArthur, Tenino, Wash.

A locomotive boiler including a fire box and a combustion chamber, there being a flame receiving opening in the bottom of the combustion chamber through which communication between the fire box and combustion chamber is constantly maintained. There is a constantly open air inlet in one wall of the combustion chamber, the bottom of the chamber being arranged to direct unconsumed particles through the bottom opening and back into the fire box. There is also a smoke box, flues connecting the smoke box and the fire box, a single flue connecting the upper portion of the smoke box with the lower portion of the combustion chamber, and flues extending from the upper portion of the combustion chamber to the smoke outlet.

JOURNAL BOX.

1,015,529—George A. Woodman, assignor to Kirby Equipment Co., Chicago, Ill.

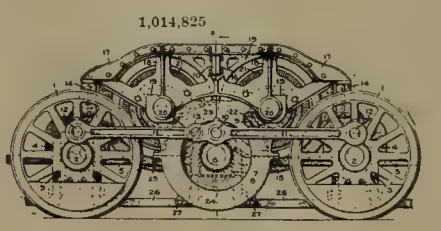
A sectional journal box comprising a pressed steel body section, and a cast yoke section embracing the body section and having two arch bar seats integrally connected together by a pair of standards.

CAR COUPLING.

1,015,533—Landon Botchlor, Lawrenceberg, Ind.

This patent is a drawhead having a bifurcated jaw and a rotating knuckle, a ball chamber within the drawhead, a ball movable therein, the lateral wall of the ball chamber having a slot therein through which, the tail of the knuckle projects. A locking lever is pivoted on a horizontal axis with its center of gravity in front of and below the pivotal point, and provided with claws to engage the ball on opposite sides, and a recess to receive and carry the ball. The upper claw of the locking lever holds the ball within the pathway of the travel of the knuckle hook. Means are provided whereby the knuckle may be rotated when the ball is shifted by the shifting of the locking lever.

1,014,825



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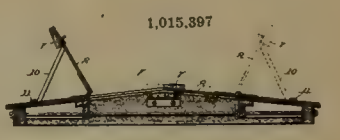

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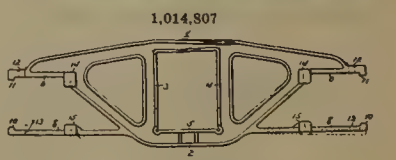

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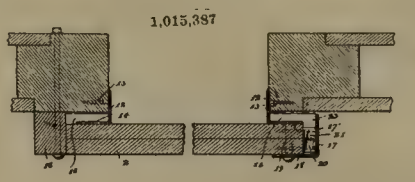

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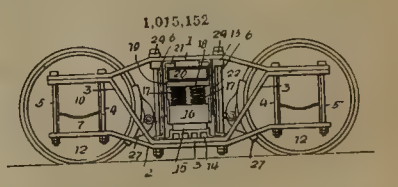

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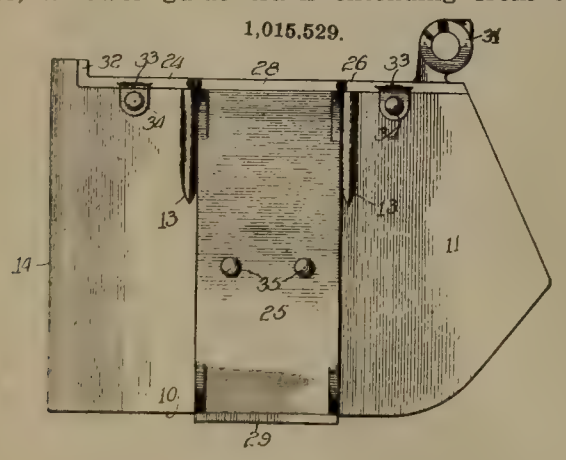

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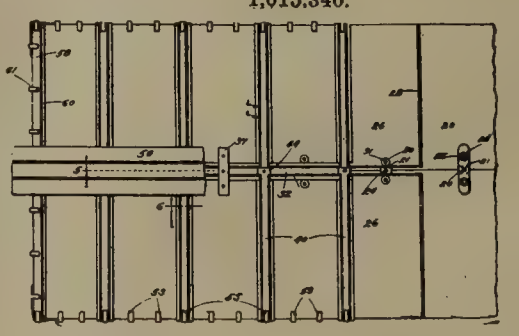

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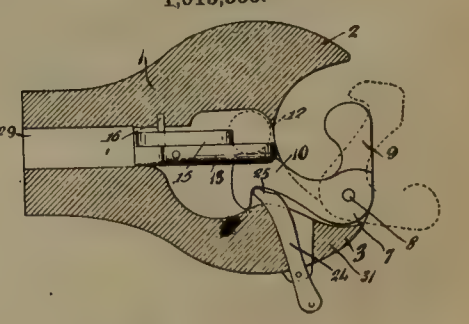

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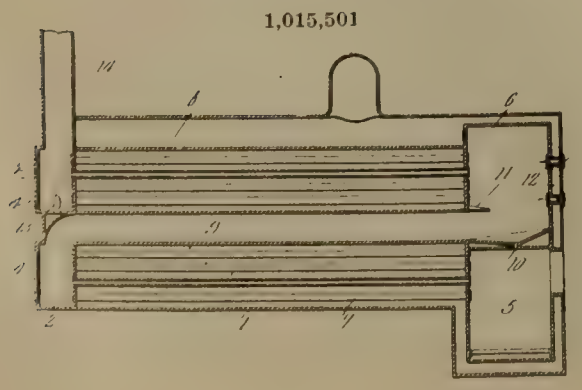

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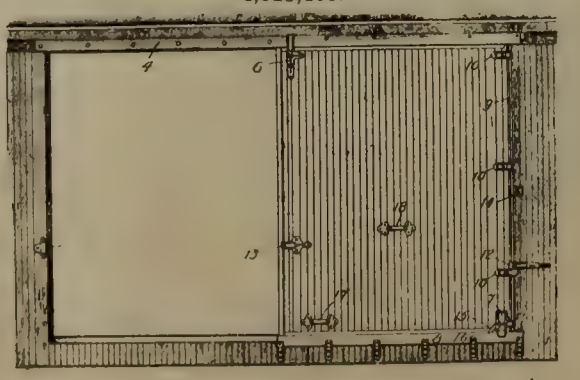

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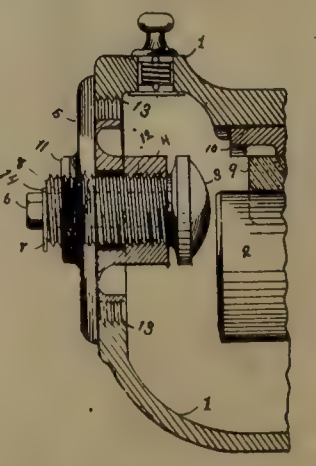

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LOCOMOTIVE MANUFACTURE IN THE RAILWAY REPAIR SHOP.

The question of just how far a railway can successfully enter the manufacturing field through the use of its own shop forces and shop equipment, is somewhat hackneyed. So many arguments of local application only, have bearing and are used on both sides in the consideration of the subject, that general conclusions seem impossible. Several railways have undertaken the manufacture of motive power as well as other rolling stock on a large scale and it is not difficult for their officials to show distinct financial advantages gained thereby—if we accept their method of computing. Similarly those who favor the purchase of all equipment from specialists among manufacturers are able to produce figures conclusive in their favor if it were not for the fact that they usually refuse to take into consideration certain contributing facts which have to do with local conditions at the railway shop, such as the continuous employment of forces and machinery which would otherwise be on short time.

The Atchison, Topeka & Santa Fe has built a number of locomotives in its Topeka shops which are admirably equipped for the purpose, but it must be stated that much of this work was of experimental nature which, it was judged, could be best handled at home. The Chicago, Milwaukee & St. Paul has made a remarkable showing along these lines in that it has built upwards of five hundred and fifty locomotives in shops not of modern type and of only ordinary equipment. These engines are representative of nearly every class in use on the road and are giving or have given good account of themselves in exacting service.

On another page of this issue we describe and illustrate one of an order of fifteen Pacific type passenger engines now being built at the Milwaukee shops of the Chicago, Milwaukee & St. Paul Ry. These engines are of exceptionally excellent design. There has been worked into their construction every applicable idea which has been developed to such extent as to warrant its use. The use of the brick arch is in accord with practice of long standing on this road. The installation of Schmidt superheaters is not looked upon here more than elsewhere as experimentation. The DeVoy trailer trucks have rendered service creditable to their inventor. Generally speaking it is doubtful if a class of locomotives, better adapted to strictly local conditions of service, was ever furnished an operating department. With respect to the cost of manufacture it is probable that we will be able in a later issue to publish some very interesting figures.

BETTER MATERIALS AND BETTER WORKMANSHIP DEMANDED.

Retrenchment and the agitation for economy has during the last few years operated to lower standards of quality and workmanship in railway shop repair and construction work. This is a fact which, al-

though humiliating to admit, becomes evident when working conditions, which should not, in the experience of foreign railways, be termed anything but ordinary, are imposed upon rolling stock. Use of the superheater has developed, in locomotives, troubles which may be attributed solely to poor materials and poor workmanship judged by the standards of years ago, or by those of other countries. One road reports fair success with a certain superheater, while another obtains discouragingly poor results with the same superheater in the same type of power. Study of the conditions reveals with surprising frequency that the first road has simply cut down on the quality of material and workmanship a little less than the second.

Good practice in the use of the superheater demands, for instance, that piston rings not only be made of metal which will not partially fail under the high temperatures and conditions in connection therewith, but that they be reshaped on the lathe or mill after having been sawed and sprung. This process is one with which nearly every master mechanic is familiar—it was customary in the careful work of his apprenticeship. It was discontinued as an unnecessary expense in later years but it must be readopted if the best results are to be obtained from superheating. It has been found in tracing lubrication difficulties, that the use of the best grade of metal in the cylinder casting of superheater locomotives is of paramount importance. In recent years so little attention has been paid to the grade of metal used in these castings that troubles have developed on this account even with saturated steam locomotives. Needless to say the application of the superheater forced attention to this detail.

Generally speaking a certain reversion to early principles in specifications for manufacture and particularly in the maintenance of locomotives which are destined for exacting service, is demanded.

LOCOMOTIVE EFFICIENCY.

What we consider one of the most important, interesting and instructive articles on locomotive efficiency is that written by Earnest Cordeal, bonus supervisor, Atchison, Topeka & Santa Fe Ry., and published on another page of this issue. Mr. Cordeal has advanced what seems to be a new method of ascertaining the facts with respect to a somewhat elusive subject. His article shows originality and is evidently the result of considerable study. His formulae may be open to criticism, but nevertheless they come nearer to being the means of obtaining absolute and accurate figure bearing on his subject than any thus far suggested.

We believe that Mr. Cordeal has produced a means of arriving at standards for locomotive operation, which should prove of real value to mechanical department officials in comparing performance efficiency between various divisions. In view of the fact that most students of such problems have confessed at one time or another their inability to find a system whereby such comparisons can be made, this contribution will receive unusual consideration.

STARTING SOMETHING.

It is often very noticeable that it is difficult to get up a lively and enthusiastic discussion of papers presented before various railway clubs. In general this is not because the papers are uninteresting and do not cover the subject; in fact, perhaps the contrary is true. Most of the papers presented are good and show a considerable amount of work on the part of their authors. Occasionally advance copies of the papers are not sent out by the secretary in sufficient time for the members to look them over before coming to the meeting and this, of course, is a great drawback to an enthusiastic discussion. There are always plenty of the members who are qualified to discuss any particular subject; the difficulty is to get them started. Often a presiding officer will call on half a dozen members before getting one who will say something, and then oftentimes the member will say that he can add nothing as the speaker has covered his viewpoint so thoroughly. A presiding officer can do much to enliven discussion but he can not extract it from the mouths of members with a pair of forceps. The stimulus for discussion must come from the paper itself.

One thing is noticeable, however, that papers which present a general view of a subject from all sides do not provoke as much discussion which a paper does which presents a one-sided view. The paper which considers the subject from all angles does not leave room for as much discussion because of the fact that it touches the viewpoint of practically all present. But if the writer of a paper to be given before a railway club, wants to start something, let him incorporate into his paper a very decided view on the subject in hand; let him give a positive opinion on every point and state that this is the only viewpoint which can be taken of the matter. Such a paper will not lack for discussion for immediately when you state a positive viewpoint, it will arouse a combative spirit and everyone will take a turn at the speaker. It may not be so pleasant for the speaker but it will be much more beneficial for the society as a whole. It is difficult to get up much of a discussion on such a paper as "The Development of the Locomotive," for instance, but it would be pretty easy to get up a lively discussion on a paper in which the writer strongly favored making box cars entirely of steel. Of course it is not contended that the writer of papers make absurd claims or statements, but rather that they present all the strongest facts and arguments in support of one view of the question, which will give the members a chance to bring out their arguments in support of other ideas and thus provide room for discussion. And it need not detract from the value of

the paper, which would then cover one idea thoroughly. The man who prepares a paper gets a great deal of good from it, but he should try to share the benefit with the members, for the problem with most of our clubs today is to keep a lively interest among its members. The next time you have to prepare a paper, leave something for your listeners to do, too; start something.

THE COST OF COLD WEATHER is shown in the reports of railroad earnings for the month of January. It cost the Chicago & Northwestern 97 per cent of its revenue to operate and its report shows a deficit of $587,469 for the month. The net revenue for January was $115,778, as compared with $1,445,452 for December, which startling difference is accounted for largely by the difference in weather conditions. The Chicago Great Western, the Erie, Union Pacific and a number of other roads show corresponding decreases in net revenue for the same period. The Canadian Pacific, on the other hand, shows a net increase in revenues, although there was a large increase in operating expenses. The combination of snow and cold weather strikes both the receipts and expenses, for in addition to the increased cost of operation, the receipts fall off due to the inability to handle traffic. This inability is due to clogging of switches, difficulty in keeping up steam, keeping tracks clear, assembling trains and the numerous other difficulties which railroad men know only too well. The months of January and February, 1912, have been the worst in years for railroad operation, and this has also been evinced by the numerous wrecks which have occurred. It seems that anti-railroad legislators have even enlisted the weather-man to their cause.

THE COMMERCE COURT and the Interstate Commerce Commission continue to conflict with each other and the controversy between the two was made more acute by a recent decision of the court which annulled a decision of the Commission regarding certain freight rates of the Louisville & Nashville between New Orleans and a number of nearby cities. The New Orleans board of trade alleged that the Louisville & Nashville had made discriminating rates against New Orleans and the commission upheld the board's contention by reducing the rates. The commerce court, after a thorough hearing, decided that there was nothing to justify the reduction, which the L. & N. had said would result in a loss of $200,000. The court stated that the interstate commerce commission has assumed a great deal of authority which Congress never intended for it. However at the time of its formation, a commerce court was not contemplated and it can scarcely be denied that the interstate commerce commission has been doing its work well and has rightfully used any powers it has assumed. Certain members of Congress are now making efforts to have the Commerce Court abolished, although the president has said that he will veto any legislation along this line.

AN INVESTIGATION is to be made by a committee of the National Association of Railway Commissioners on rails and railway equipment. This committee is composed of J. E. Sague, of New York; W. J. Wood, of Indiana, and Charles Elmquist, of Minnesota. It will hold a number of hearings and will endeavor to make recommendations regarding improving the quality of equipment, in its report.

FIRST AID TO THE INJURED is being taught to the employees of the Delaware, Lackawanna & Western, by series of lectures and by the distribution of booklets on the subject. Instruction classes are also held in which the practical application of the methods is practiced upon some one of the men.

Packets of gauze, bandages and other first aid materials are placed at various points in and about shops, round houses, yards and stations. The system has been extended to all departments and when an employee uses one of the packets, he sends in a report of the accident to the proper official. It is well known that the first few minutes following an accident are the most important and therefore the necessity of having competent first aid is a very essential feature. Perhaps the greatest difficulty will be to keep up an interest in the work when its practical application is required infrequently

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THE HOOSAC TUNNEL of the Boston & Maine near North Adams, Mass., was blocked on February 20 by a rear end collision between a string of freight cars and a passenger train. This tunnel was recently electrified as described in the November, 1911 issue of the *Railway Master Mechanic*. The steam locomotives are now towed through the tunnel, with their fires banked. A freight train had been stopped at the east portal of the tunnel and the passenger train, with its electric locomotive ahead of its steam locomotive, crashed into it. Four men on the electric locomotive were killed and a fire at once broke out. The heat was so intense that nothing could be done to clear the tunnel and it is said that considerable damage was done to it. No passengers were injur d.

TESTS ARE BEING MADE of Chicago's air by the commission on electrification, in order to determine just what it is composed of and to ascertain the percentage of carbon dioxide, sulphates, nitrate and solid matter. An effort is to be made to determine the percentage of pollution due to locomotives, factories and office buildings. If this test is fairly carried out it will show that the railroads have been taking the blame for a large percentage of pollution which is caused by other agencies and it is hoped that the report will be given due publicity.

THE REPORT OF THE FEDERAL EMPLOYERS' LIABILITY and Workmen's Compensation Commission was transmitted to the president on February 14. The report is practically as outlined in the January issue of the *Railway Master Mechanic*, providing specified and compulsory payments by the railroads to their employees in case of accidental death or injury. It was considered by the president and transmitted to Congress with a message urging its enactment, although it is probable that it will not come up until the next session.

Pacific Type Locomotives, C. M. & St. P. Ry.

Among roads building their own equipment, the Chicago, Milwaukee and St. Paul has always taken a leading place, and the shops at Milwaukee, Wis., have turned out a large number of locomotives and cars, as may be attested by the fact that altogether over 550 locomotives have been built there.

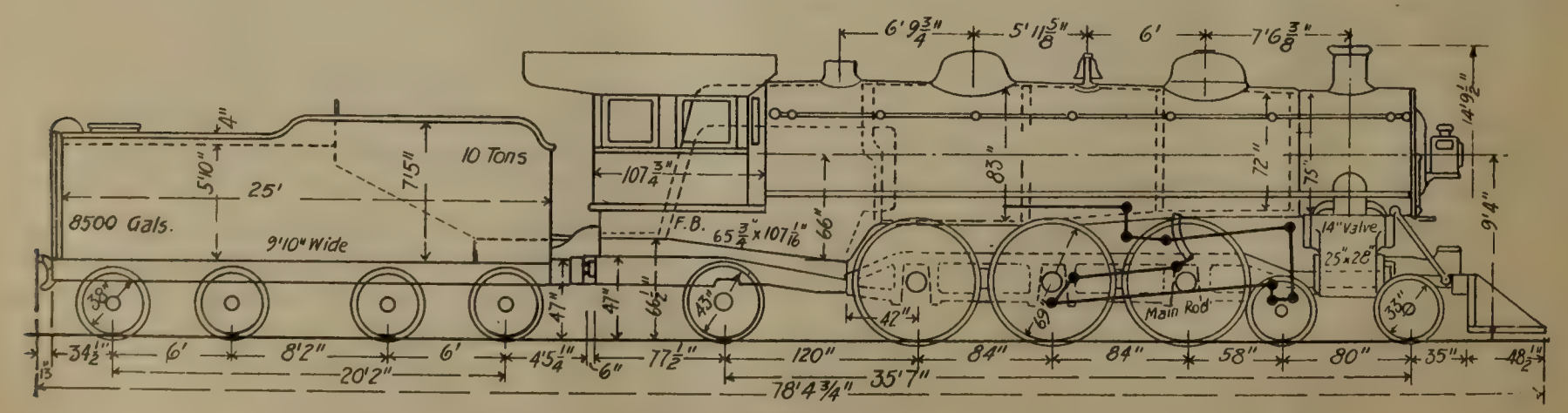
These shops are now working on an order of 15 Pacific type engines for passenger service. Nine of these have already been put in service, and the remainder are on the pits in advanced stages of completion. These engines were necessitated not only by the growing needs and scope of the road, but also by the increasing use of heavy steel coaches with the consequent need of more and heavier motive power, as on an average 12 steel coaches are about equal in weight to 15 wooden ones. The engines are to be used for heavy passenger service between Chicago, Milwaukee and Minneapolis. They are known as class F 5, numbers 3100 to 3114, inclusive, and are similar in design to the present type of Pacific engine in use on the St. Paul with the exception of the addition of a superheater. For this reason they have a tractive force of 39,000 pounds as compared with a tractive force of 36,500 pounds on the present saturated steam engines. The weight is practically the same as of the present Pacifics, with the addition of 2,000 pounds for the superheater. The heating surface has been increased by the addition of the superheater to 3,633 square feet. The superheater is of the improved Schmidt fire tube type as manufactured by the Locomotive Superheater Co., of New York, and has outside steam pipes leading down directly to the valves, thus relieving the smoke box of congestion. The 1½-in. superheater pipes are placed in 28 flues, 5⅜-in. in diameter and the total heating surface of the superheater flues and pipes is 1,365 sq. ft. The boiler is of the wagon-top type, carrying 185 pounds steam pressure. The firebox is equipped with a brick arch; in fact, all engines on the St. Paul are so equipped. It is provided with rigid staybolts, radial staying and has the standard hand rocking grates. The Walschaerts valve gear is used with standard reverse quadrant and the eccentric crank has a throw of 20 ins.

Frames have a spread of 43 ins. and were made at the Milwaukee shops. The cylinders are 25x28 ins. and are supplied with balanced piston valves, which have a travel of 6 ins., with 1¾-in. steam posts and 2⅜ exhaust ports. They are equipped with a five feed lubricator, the two additional feeds being applied to the cylinders on account of the use of superheated steam. Trailer truck is of the De Voy inside bearing type. The tender underframe is made of 13-in. channels and the tender has a capacity of 8,500 gallons of water and 10½ tons of coal. Its weight, light, is 62,700 pounds, and it is 25 ft. in length by 9 ft. 10 ins. in width. The illustrations show a general view and detailed arrangement of the locomotives.

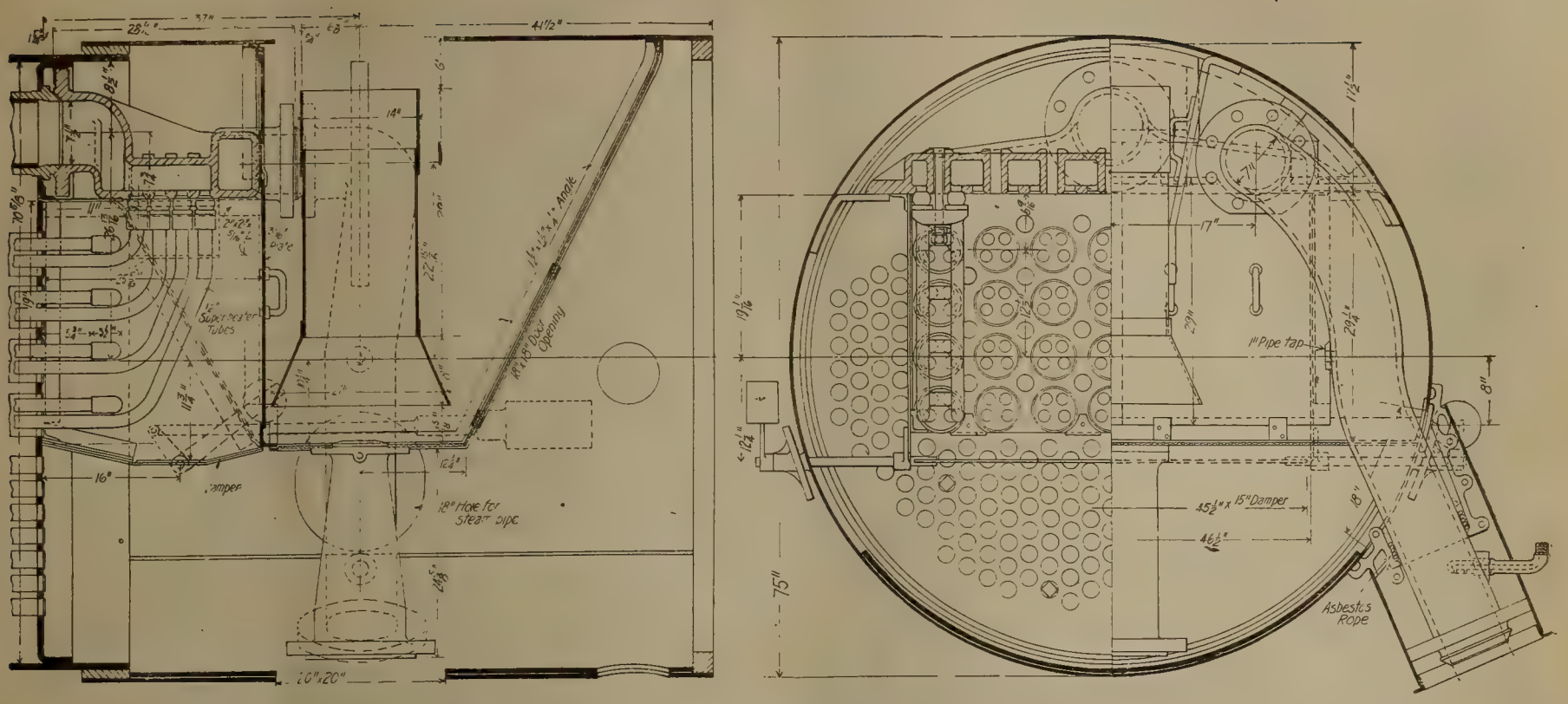
Pacific Type Locomotive Built at Milwaukee Shops, C. M. & St. P. Ry.

Following is a table of weights, dimensions and ratios:

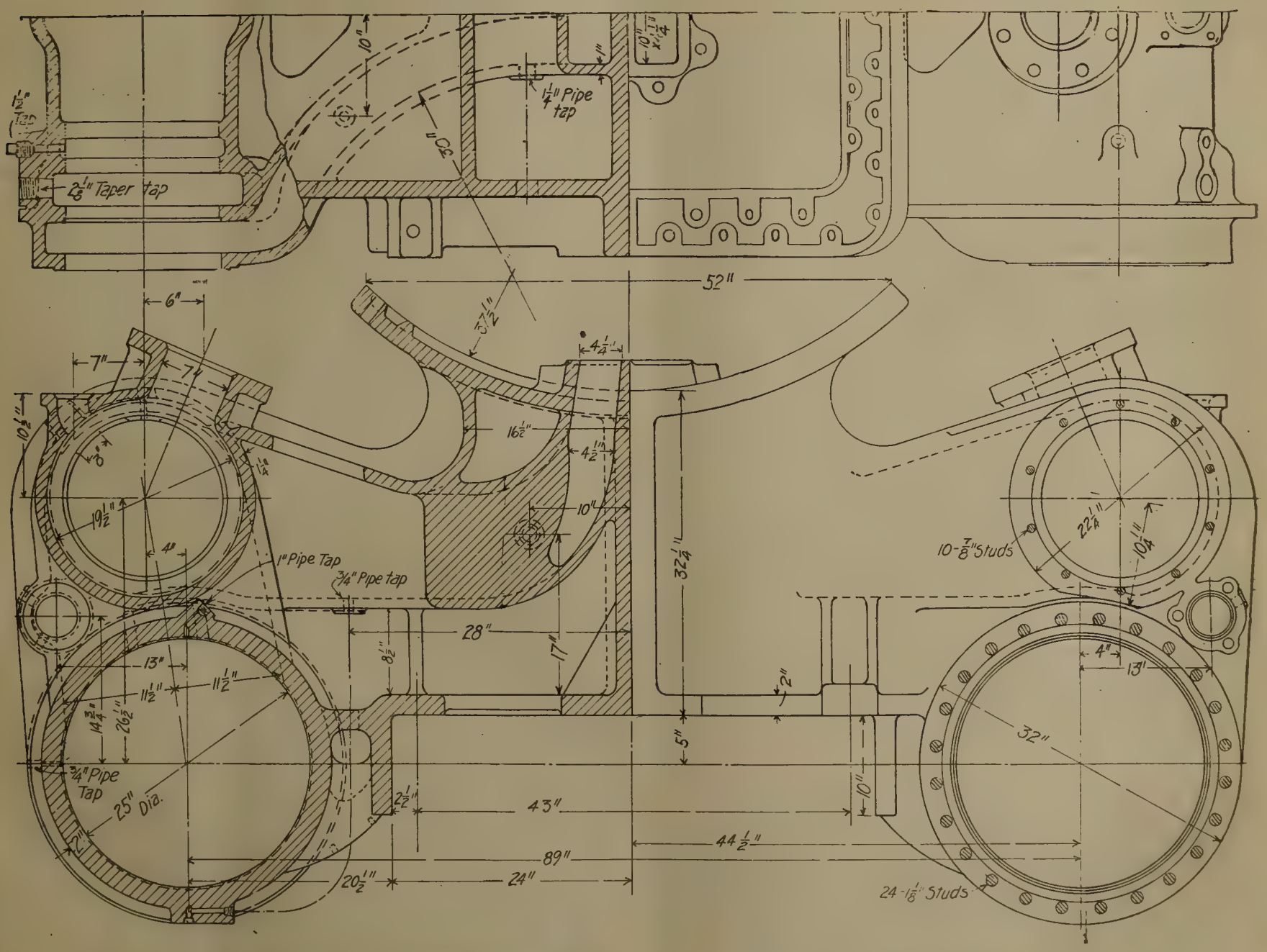
Gauge	4 ft. 8½ ins.
Cylinders	25x28 ins.
Valves	Balanced piston
Boiler—	
Type	Wagon top
Material	Steel
Diameter	72 ins.
Working pressure	185 lbs.
Fuel	Coal
Staying	Radial
Fire Box—	
Material	Steel
Length	107 1/16 ins.
Width	65⅜ ins.
Thickness of sheets, sides	⅜ in.
Thickness of sheets, back	⅜ in.
Thickness of sheets, crown	⅜ in.
Thickness of sheets, tube	⅝ in.



Elevation Showing Principal Dimensions, Pacific Locomotives, Built by C. M. & St. P. Ry.



Front End of C. M. & St. P. Locomotives, Showing Arrangement of Superheater Header and Outside Pipes.



Cylinder and Saddle Castings, Pacific Type Locomotives, C. M. & St. P. Ry.

Water Space—	
Front	4½ ins.
Sides	4 ins.
Back	4 ins.
Tubes—	
Diameter	5⅜ and 2 ins.
Material	Steel
Thickness	
Number	5⅜ in., 28; 2 in., 203
Length	19 ft.
Heating Surface—	
Fire box	179 sq. ft.
Tubes	2,009 sq. ft.
Arch tubes	27 sq. ft.
Combustion chamber	53 sq. ft.
Superheater flues	745 sq. ft.
Superheater pipes	620 sq. ft.
Total	3,633 sq. ft.
Grate area	48.8 sq. ft.
Driving Wheels—	
Diameter, outside	69 ins.
Diameter, center	62 ins.
Journals	10½x12 ins.
Engine Truck Wheels—	
Diameter, front	33 ins.
Journals	6½x12 ins.
Diameter, back	43 ins.
Journals	8½x14 ins.
Wheel Base—	
Driving	14 ft.
Rigid	14 ft.
Total engine	35 ft. 7 ins.
Total engine and tender	68 ft. 3¾ ins.
Weight—	
On driving wheels	162,000 lbs.
On truck, front	46,000 lbs.
On truck, back	42,700 lbs.
Total engine	253,000 lbs.
Total engine and tender, about	407,000 lbs.
Tender—	
Wheels, number	8
Wheels, diameter	34½ ins.
Journals	8½x14 ins.
Tank capacity	8,500 gals.
Fuel capacity	10½ tons
Service	Passenger
Ratios—	
Weight on drivers ÷ tractive power	4.06
Total weight ÷ tractive power	6.34
Tractive power × diameter drivers ÷ heat surface	757.46
Total heating surface ÷ grate area	74.44
Firebox heating surface ÷ total heating surface, per cent	4.92
Weight on drivers ÷ total heating surface	52.10
Total weight ÷ total heating surface, per cent	69.63
Volume both cylinders, cu. ft.	15.90
Total heating surface ÷ volume of cylinders	228.
Grate area ÷ volume of cylinders	3.07
Factor of adhesion	4.06

SOME ENGINE.

The Chicago, Burlington & Quincy system has ordered five engines that are expected to handle 60,000-ton freight trains over any ordinary grade on its roads. The new engines will be equipped with automatic stokers and either slack or crushed coal will be the fuel used.

If these engines prove satisfactory, a large number will be ordered for the Galesburg division in the coal fields and for general freight traffic. They will be put in service next fall.—*Power.*

THE COUPLER PROBLEM.*

By J. B. Thomas.

It will be noted that throughout the entire discussion of the coupler problem at the M. C. B. convention in 1911 the minds of the several speakers (F. W. Brazier, J. F. Deems, J. J. Hennessy, C. E. Fuller, C. A. Schroyer, J. F. Walsh) were focused upon devising some way by which the diversity of designs in couplers could be reduced to one or two, with their several perishable parts interchangeable. To my own mind there is a way—and that a simple one—to accomplish this end. It will be remembered that at the M. C. B. convention of 1910 two specific essentials were agreed upon. These were: First, the bearing surface of the lock against the knuckle tail should be at least four square inches; second, the knuckle throw should be so designed that it would force the knuckle open to the limit from any position the latter might assume incidentally or otherwise. In designing a coupler that would meet with these specific requirements the principal question involved is that of durability. Quite a few designs of couplers possessing these functions in their incipient stage had been extensively applied in previous years, but a few months' service had demonstrated the fact that not one of them could be counted as reliable. In fact, the mechanism of most of them would become so seriously impaired, after a few shocks, the Master Car Builders' Association had to condemn the principle upon which they had been constructed; namely, that of being operated by a vertical lift through a hole cast in the top of the coupler body. The one remedy for this is to have the lock, lock set and knuckle throw to move in a horizontal plane, and consequently in harmony with the natural movement of the knuckle. This design has been perfected to such an extent that the several parts are guaranteed not to become impaired either by service shocks or by ordinary wear. This guarantee is made in the form of a clause in the contract, which reads as follows:

"For every five couplers orders an extra set of the lock mechanism will be supplied free of any additional cost; and, if any of the several parts of the lock mechanism in any drawbar shall fail because of wear or breakage of such pieces before the drawbar itself shall have been broken or worn to a point where it will have to be retired from service, such pieces will be renewed upon receipt of broken or worn pieces of such lock mechanism free of cost."

The reader cannot fail to understand that such a concession can be made only in case the parts pertaining to the lock mechanism are not subject to impairment by either breakage or wear. The contention of the designer of this coupler is that the lock mechanism—in any of its features—is thoroughly protected by the coupler head. According to the computation given out by Mr. Brazier and others, the defective lock mechanisms now in existence are costing the railroads millions every year to maintain them. The designer—and developer—of this coupling device would also inform the railroads that no one manufacturing concern has a monopoly of same; that in contracting for this coupler any railroad can indicate its preference as to the concern which shall manufacture same, provided such concern will consent to fill such orders at a price equal to that of the lowest bidder, a complete set of patterns being furnished without cost. One of the most important features of the design of coupler here referred to is the fact that it will operate in the same measure of efficiency as many as twenty different designs of knuckles now known to be in use. The bearing surface of the tails of these several knuckles against the lock of this coupler is from 50 to 75 per cent greater than they are

*From a paper read before the St. Louis Railway Club, Dec. 8, 1911.

against the locks for which they were specifically designed. With these claims set forth—the designer of such a coupler assuming the burden and expense of proving same—the only thing that is left for the M. C. B. coupler committee to do is to specify:

First, that the coupler designed for a standard shall stand the drop test prescribed by the M. C. B. Association, and a pulling strain of 250,000 pounds; second, that there shall be at least four inches bearing surface of the lock against the knuckle designed for same; third, that the lock set should automatically release the lock only after the knuckle has been pulled open or partially so; fourth, that the knuckle throw must force the knuckle open to the limit from any position it might assume by the manipulation of the uncoupling rod or lever; fifth, that it shall not be subject to impairment from service so long as the coupler body is not broken or worn to a point where it is necessary to retire same from service; sixth, that it should receive and operate with the same measure of efficiency at least five different designs of knuckles, any one of which shall have been previously applied to at least 50,000 freight cars.

It is a self-evident proposition that such a design of coupler is the only one that can possibly meet with future requirements of service, and the sooner steps are taken to raise the coupler to such a standard of requirement the better it will be for all concerned.

RAILWAY MOTOR PASSENGER CARS.

On Jan. 19, W. B. Potter, chief engineer railway department, General Electric Company, read a paper on self-propelled cars before the New York Railroad Club. He described his company's gas-electric cars, which weigh 40 tons to 50 tons and are capable of a maximum speed of 60 m.p.h. Electric control and transmission were used to utilize the inherent characteristics of the gas engine to the best advantage and to relieve the engine from mechanical strain and shock. Series-parallel motor control and regulation of the generator voltage gave a wide range of speeds. The tractive effort at the slower speeds was 12,000 lb. or more. As there was no mechanical connection between the engine and driving wheels, the engine could be slowed or shut down without regard to the control system. With the car standing still or moving the power of the engine could be safely applied in either the forward or reverse direction.

Mr. Potter stated that the engine used on these cars had eight 8-in. x 10-in. cylinders and at the normal speed of 550 r.p.m. would deliver 100 kw. to the motors with some margin to spare. The gasoline most used was "painters' naphtha," which could be purchased for about 6 cents per gallon.

The motors, which were standard 600-volt railway machines, were mounted on the forward truck under the engine, thus placing about 65 per cent of the total weight of the car on the driving wheels. As the traction voltage varied from 200 volts to 800 volts, the current for lighting the car was supplied by a separate gas-electric generating set. The two-cylinder engine of this set also had an air compressor cylinder for supplying compressed air to start the large engine. The cars had both straight and automatic air brakes, the latter for handling trailers. The engine compartment is in the forward end and is about 12 ft. long.

Performance curves of a 70-ft. car, as submitted by Mr. Potter, showed that with stops 2 miles apart the schedule speed would be about 25 m.p.h. and the maximum speed on level track about 60 m.p.h. He also presented the following table, showing the comparative cost of operating a train of two coaches and a steam locomotive and of a gas-electric car on a daily run of 150 miles, except Sundays, amounting to 3,900 miles a month:

Mr. Potter also gave a table, published above, for three months' operation on the Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company ("Dan Patch" line), which operates five of these cars. The stations on this line are 1.4 miles apart. The figures cover operation over 37.5 miles between Minneapolis and Northfield for July, August and September, 1911.

Mr. Potter further suggested certain forms for keeping an accurate record of the cost of operating such motor cars with or without trailers.

In conclusion Mr. Potter said that a special study has been made to secure a light-weight car for this service. The body weighed 28 tons, the trucks 6 tons, and the motive power equipment 15 tons, a total of 49 tons for a 70-ft. car. This was equivalent to 1,000 lb. per seated passenger. The gas-electric car had proved very reliable in the coldest weather. The "Dan Patch" line had operated during very heavy snow with the temperature 15 deg. to 30 deg. below zero when steam trains in the same territory were helpless. This line was using painters' naphtha at 5½ cents per gallon.

TWO-TRAILER STEAM TRAIN VS. ONE GAS-ELECTRIC CAR.

	Steam Train per Mile.	Motor Car per Mile.
Wages of crew:*		
Engineer or motorman	$0.0400	$0.0400
Fireman	0.0240	.....
Conductor	0 0280	0 0280
Baggagemaster	0.0183	0.0183
Total wages of crew	$0.1103	$0.0863
Fuel, water and engine lubrication:		
Coal for locomotive, 67 lb. at $2.25 per ton	$0.0750	.....
Water for locomotive	0.0050	.....
Painters' naphtha, 6 gal., at $0.06 per gal.	.....	$0.0360
Engine lubrication	0.0025	0.0050
Other expenses:		
Locomotive, repairs	0.0850	.....
Locomotive, engine house expenses	0.0050	.....
Coaches (2), repairs and expenses	0.0250	.....
Gas-electric motor car, general overhaul	.....	0.0215
Gas-electric motor car, running repairs and expenses	.....	0 0210
Other supplies	0.0025	0.0050
Superintendence	.....*	0 0065
Total cost per train mile	$0.3303	$0.1813

*Based on no overtime allowance.

*For steam locomotive this is assumed to be included in items of locomotive repairs and engine house expenses.

Saving per train mile	$0.1490
Saving per diem (except Sunday), 150 miles a day	22.35
Saving for twenty-six-day month	581.00
Gross yearly saving	6.970.00

NOTE.—When no baggage and express is handled and when operating conditions will permit the gas-electric motor car can be operated without the third man.

THREE MONTHS' OPERATION OF GAS-ELECTRIC CARS.

Number of days actual service	92
Total mileage, five motor cars	39,352
Number of trailers hauled occasionally	1 or 2
Total mileage trailer cars	7,879

	Total.	Per Train Mile.
Total wages of crew	$2,249.40	$0.0573
Fuel and lubrication, engine:		
24,944 gal. of gasoline at $0.062 per gal.	1,534.20	0.0391
755 gal. of gas engine oil at $0.25 per gal.	189.76	0.0048
Running repairs and expenses:		
Total running repairs, material and labor	410.36	0.0104
Car cleaning, materials and labor	135.70	0.0035
Other supplies	81.83	0.0021
Total expense	$4,601.25	$0.1172

The proceedings of the nineteenth annual convention of the Traveling Engineers' Assn. are published in exceptionally neat and attractive style. The books are bound in flexible leather, all diagrams and tables which could not be reduced to read clearly within the limits of the pages are placed on folded inserts. This year there are ten obituaries for deceased members as follows: A. J. McKillip, J. M. Burford, D. J. McOsker, C. E. Randall, L. S. Ross, H. E. Stone, Chas. Davis, J. F. Patterson, F. J. Bullock and F. L. Woolwine. A complete list of the membership of the association is included and the book is carefully indexed.

Locomotive Efficiency

By Ernest Cordeal, Bonus Supervisor, A. T. & S. F. Ry.

The efficiency of the work performed by locomotives in service is a question which, by reason of its relative importance in the problem of conducting transportation, deserves the greatest consideration.

Comparison of performance on the usual bases are at the best mere makeshifts, reflecting a condition without taking into consideration extenuating circumstances, nor in any way suggesting means of improving past records.

A report showing the gross tons per engine mile may reflect the fact that this year a certain division handled 1,600 tons, while the figures for the previous year were only 1,500 tons. At first glance this would appear as a good relative performance; however, on looking farther it may be found that the average speed with which this tonnage was handled was only ten miles per hour, against twelve miles per hour the previous year. It may further develop that the addition of new power had increased the average tractive force of locomotives in a per cent as great or greater than the increase in tonnage. Reductions of grade or improvement of track may have been responsible for the increase in tonnage and what appears to be a good performance may in reality only be the natural consequence of expensive betterments. It is generally recognized that comparisons between different railroads or betwen different divisions of the same road on a ton mile or engine mile basis are far from satisfactory.

Variations in types of power, differences in weather conditions, the influence of grades and curves, the density of traffic must all bear their part in determining the standard of performance for different territories at different periods.

The only way in which comparisons can be equitably made is by reducing the various influencing items to a mathematical basis, by giving them a definite value in their relation to performance, and by setting standards which comprehend these items in their ratial value. The establishment of such standards should not be attended by any great degree of difficulty. The effect of grades and curves on train resistance has been definitely determined, even weather conditions may be transposed into definite figures, the average hauling capacity of assigned power is a matter of simple calculation, and all that remains is to study the existing conditions and set standard of performance accordingly.

In determining the efficiency of the work performed by locomotives in service, there are four items which should be given consideration:

1. The proportion of time in actual service.
2. The average speed in service.
3. The average load hauled.
4. The cost of maintenance, handling and operation.

Reducing these four items to a mathematical basis, for the purpose of determining a definite efficiency per cent, we have the following formulas:

$$(1)\ \text{Service efficiency} = \left\{ \frac{\text{Hours in service.}}{\text{Total hours.}} \right\} \text{Standard ratio.}$$

$$(2)\ \text{Speed efficiency} = \left\{ \frac{\text{Engine miles.}}{\text{Hours in service.}} \right\} \text{Standard speed.}$$

$$(3)\ \text{Load efficiency} = \left\{ \frac{\text{Gross ton miles.}}{\text{Engine miles.}} \right\} \text{Standard load.}$$

$$(4)\ \text{Cost efficiency} = \left\{ \frac{\text{Standard cost.}}{\text{Total cost.}} \right\} \text{Gross ton miles.}$$

In formula one "Hours in service" includes all hours spent by locomotives between terminals, while "Total hours" is figured at twenty-four hours a day for each assigned engine whether in actual service, in shop or laid up.

In formula two "Engine miles" includes the total mileage of all engines assigned, "Hours in service" being the same as in formula one.

In formula three "Gross ton miles" and "Engine miles" are self explanatory.

In formula four "Total cost" includes all items of service, such as repairs, labor and material, enginemen's wages, enginehouse expenses, cost of fuel, lubricants and supplies.

The determination of service efficiency provides a means of checking and comparing the records of various divisions or various periods. as regards the actual amount of time service rendered by locomotives in relation to the total amount of power assigned. A variation in service efficiency between different divisions or between different periods on the same division may indicate any one or a combination of a number of conditions. A low efficiency in this item might be the result of an overassignment of power in relation to the amount of business to be handled. Again, the cause might be in the fact that locomotives were detained for excessive periods while undergoing repairs or waiting for shop room. Lack of expeditious handling at enginehouses would also have a tendency to lower the efficiency of this item. A high service efficiency would presuppose an equitable assignment of power; it would mean that shop detention was not excessive and that handling and repairing of locomotives at enginehouses was being performed without loss of time. It would not follow, however, that the division, with the highest service efficiency, was the most faultlessly handled, as a high quality of service may be attained at the expense of other items.

High service efficiency together with low speed efficiency would not reflect a creditable condition, nor would high service efficiency coupled with high speed and low load efficiency indicate economic performance. A low cost efficiency together with high service efficiency might mean that power was being handled and repaired more quickly than was consistent with reasonable unit cost.

The item of speed efficiency is of particular value as a check on the service and load features. Locomotives may be loaded beyond the economic limit, but such a practice would immediately make itself evident by a decrease in speed efficiency. Power may be kept in service a longer proportion of the time than is consistent with efficient operation. This condition would have its effect not only on speed, but on load and cost efficiency as well. It is not enough that locomotives should spend the desired amount of time in actual service, nor that they should pull their allotted tonnage, but they should also be able to make a certain performance as to miles per hour.

In the present day of sixteen hour laws the speed with which trains can be handled over a division takes on an added importance over and above a mere question of economy of operation. There is, of course, an economic limit to the speed at which trains should be handled, which being overstepped will be indicated by a rapidly decreasing load efficiency. Some place between the extremes of high speed and light tonnage and low speed and heavy tonnage lies the efficient and economic means which renders possible the handling of the maximum amount of traffic at the minimum cost. This point where speed and tonnage meet, to give the best performance, is an elusive thing not to be guessed

at or arbitrarily set for all conditions and all times, but to be determined by careful study of conditions and facilities and an intelligent reading of trial results. No better data can be furnished to assist in the determination of this mean than that provided by the interrelation of service, speed and load efficiencies.

Load efficiency is an item of much importance and it has undoubtedly been given the greatest amount of study by men versed in the science of railroad operation. Leaving out of consideration the question of time and cost of operation, the maximum load which an engine could pull would be the ideal tonnage rating, but such a rating in practice would so decrease the efficiency of service and speed and increase the cost per unit as to far more than nullify the increase in load efficiency. Comparative figures covering tonnage per engine mile are useless as far as determining the relative efficiency of different divisions or different periods is concerned, unless compared with a carefully prepared standard, varied to conform to conditions and facilities. Comparing the tonnage of today with that of twenty years ago, the increase appears marvelous. However, by introducing into the equation the relative tractive force of locomotives, then and now, we find that our railroad forefathers were not behind us in efficiency of loading, but were accomplishing, with the facilities available, feats that to us would be stupendous. The fact that some divisions are level and devoid of curves, and that others are encumbered by both, that the types of power vary with different districts, and that railroads operate both in summer and winter seasons, does not mean that intelligent, equitable comparisons cannot be made; but it does mean that careful study is necessary in setting the standard by which each division shall be measured, and it means further that the standard of today cannot be the standards of tomorrow. Changes in conditions, improvements in roadway, development of power, must be taken care of by constantly revised standards.

Cost efficiency is the item demanding the closest attention from mechanical department officials. The steady increase in the remuneration of labor of all classes, and the greatly increased cost of materials used, have made it imperative that the greatest amount of economy consonant with good service be exercised. Efficient methods must be introduced to bring to a minimum the labor charges. Conservation of materials must be practiced to a degree unheard of in the past. Economy in use of fuel, lubricants and supplies must be made a study in order that wastes of all kinds may be eliminated. It is impossible to set an arbitrary standard of cost covering all conditions and all periods of time. No matter what the basis of comparison may be the results obtained by correlating the records of different divisions or different periods must be at variance. Making a comparative study of the cost of locomotive repairs it will be found that the variation, on any basis you desire to use, amounts to hundreds of per cent, as between various systems.

Borrowing figures compiled by the Interstate Commerce Commission, we find that on a train mile basis, cost of locomotive repairs varies from four to thirteen cents, on a locomotive mile basis from four to seventeen cents. Costs per locomotive per year range from $1,300.00 to $3,700.00. The figures representing cost per one thousand revenue ton miles show a divergence from thirty cents to $1.25, the post per pound of tractive force from five to thirteen cents per year. On the basis of the various road and work units the difference in the results is practically the same.

Taking the item of fuel for locomotives; it will be found that there is a difference between various roads on the train mile basis of from four to twenty-three cents; on an engine mile basis from eight to twenty-two cents; and on a one thousand revenue ton mile basis from forty-five cents to three dollars. The cost per locomotive per year varies from $2,200.00 to $6,000.00.

It would be ridiculous to affirm that the road which was keeping up the repairs on its locomotives for thirty cents per one thousand revenue ton miles was attaining 100 per cent efficiency, while the road expending $1.00 was only making 30 per cent. In truth the reverse might be the case. The railroad which shows a fuel cost of eight cents per locomotive mile may be less economical than that with a cost of twenty-two cents. It will be seen then that in order to make any equitable comparison between the performance of different divisions or different periods, separate standards must be set which will take into account all controlling conditions. Even after equitable cost standards have been made and comparison arrived at from this basis, it should not be considered that the division or system with the highest cost efficiency is the most economically operated. It often happens that the efficiency of locomotive operation cost must be sacrificed to the advantage of the greater item total efficiency of conducting transportation.

Any comparison then which may be made with a view to determining the relative efficiency of locomotive operation should not be based upon any single item, nor should a fixed standard be used to cover all conditions. Such comparisons should comprehend all features and should be founded on standards varying to accord with conditions.

Determination of Standards.

The standard of service may be arbitrarily set, as physical conditions, types of power or other influences should not affect the relative amount of time that locomotives are in service. On divisions with long mileage between terminals or where grades and curves demand slow speed, the longer detention necessary at enginehouses in order to put engines in condition for return trips, will equalize with the shorter mileage or more even profile of other divisions where power can be turned in considerably less time, but must be handled more often. The lapse of time will have but little effect on the standard of service, as no matter what improvements may be made in the line of roadway or power, the relative time of detention required for repairs should remain about the same. Any improvement in the facilities for handling and repairing power will, to a certain extent, be reflected by an increase in efficiency of service, but as expedient handling of locomotives is more a matter of competent supervision than of improved facilities, this feature may be overlooked in the consideration of this problem. In order to arrive at a standard ratio between locomotive hours in service and total locomotive hours, the record of all divisions for the period of a year should be perused. It will be found that, excepting a few extreme cases, there will be but little variation in this ratio. A sudden increase or decrease in business may cause the ratio to vary to a considerable extent for a short period as may a protracted siege of bad weather, but on the whole, well managed divisions will diverge but little from the straight line. Let us suppose that by compiling the year's averages for all the divisions of a system we find the best record to have been 36 per cent of the time in service, while the poorest was 31 per cent. The standard ratio should then be set slightly above the best average record, possibly at 38 per cent.

By setting the standard above the best average an incentive is provided for improvement both on the division having the best record and that having the worst, while the relation between their performance will remain the same as though the best were considered to be perfect or 100 per cent efficient and other divisions compared with its record.

In determining the standard of speed a separate study must be made of each division and district. Grades and curves must be given their time value as set forth by well known laws governing train resistance. The length of the division must be given consideration as must the density of traffic and frequency of available meeting points. Average weather conditions should not be overlooked.

The speed of trains is so closely interwoven with the load that neither standard can be set without consideration of the other. Speed standard cannot be arrived at as the result of study of past records, although such research may be of some value, and standards once set must be constantly revised to keep pace with changes and improvements in conditions and facilities. Modification of grades or curves would entail a change in standard of speed or load or very likely both. New types of power would also call for a revision of standard. Although complexed by a multiplicity of influencing features, the determination of a just and proper speed standard, at which the greatest efficiency is attainable under the varying conditions, is by no means an impossibility, nor should it be attended by any great degree of difficulty, provided the standard setter is thoroughly conversant with the subject and has at hand the data on which to base his deductions. After all information has been gathered it is a comparatively simple matter to compile tables from which can readily be determined the most efficient speed standard for any set of conditions, and after standards are once established for each separate division the necessary revisions, due to changing conditions, will become a mere matter of routine.

The subject of tonnage rating in all its complexities has received such an amount of study from the best railroad talent, of times past and present, that it should not be particularly difficult for the investigator of today to set equitable standards for locomotive loads on the various divisions of his system. The best standards of load, however, may not correspond with current practice, nor should this standard be arrived at by averaging the tonnage rating of the locomotives in service. As in the case of speed standard, map and profile must receive consideration in their relation to practical loads. The average tractive force of power assigned offers the best initial basis around which to group the other items governing load standard. Computing from the average tractive force, the most economical train load for a level straight division, the other features of curves, grades, weather conditions, length of divisions, density of traffic, economic speed, service ratio, and cost economy will express themselves as modifying per cents.

Load standards once determined are no more stable than those of speed, but must be constantly and intelligently revised to cover ever-changing conditions.

The efficient load of last year is not the efficient load of today, nor will today's standard fit in years to come. A standard, in order to be effective to provide the incentive for improvement which is necessary to advancement, must be a progressive standard, not out of reach, but far enough ahead of attainment to proclude the possibility of even the most efficient resting in the equanimity of self satisfaction. Load standards then should not be set from an average of past performance nor from the best current performance, but should conform to the best attainable performance under the governing conditions.

Standards of cost are undoubtedly the most difficult of determination of any of the four items under consideration. The variance of past and present records, as between various systems or different portions of the same system, abrogate the possibility for arriving at equitable standards from a comparison of such data. The controlling items of cost of operation are infinite and in many cases almost indeterminable.

The remuneration and efficiency of labor. The cost and quality of raw material and the distance of their source from the point of use in their various and sundry aspects must influence the standard cost of service. Standards of cost must be to a degree subservient to standards of service, speed and load. The simple fact that unit cost of service is low is by no means an indication of efficient management. In any line the cheapest article is rarely if ever the most economic. Coal at two dollars a ton may prove far more expensive than coal at five dollars a ton. Labor at thirty cents an hour may be an expensive luxury compared with labor at fifty cents an hour. Aside from the influence of varying labor conditions and cost of materials, the severity of service to which power is subjected will have its influence on the item of cost. Curves promote rapid tire wear, bad water necessitates frequent renewal of flues and fire boxes, high per cent grades, by imposing heavy and continual strain, cause rapid wear of working parts. Some types of power are more expensive of maintenance than others under identical conditions. For the purpose of deciding upon standards of cost to cover widely varying conditions, the subject should be divided into a number of separate items, each one of which should be studied individually and in its relation to all the others.

(1) Cost of locomotive repairs—labor.
(2) Cost of locomotive repairs—material.
(3) Wages of enginemen.
(4) Enginehouse expenses.
(5) Cost of fuel.
(6) Quality of fuel.
(7) Cost of lubricants.
(8) Cost of other supplies.

The item of labor should vary directly with the difference in rates of pay on the various divisions, presuppossing physical conditions to be ideal. Any variation in power types or in profile or alignment of roadway must be taken care of by increased allowance. Such allowance, however, should not be made as an off-hand estimate, but only after a careful study of all features to determine their exact bearing on the cost of labor per unit. Material allotments will be influenced by the same items as those relating to labor, and in addition must be regulated to allow for transportation charges from the place of purchase to the point of use. Wages of enginemen may be figured in direct proportion to the varying rates paid on different territories. Enginehouse expenses will be influenced by the rate of pay for the class of labor employed and by the type of power handled. Economic fuel costs should be based on price and heating value and also on thc distance transported. Lubrication standards should vary but little, although small allowance may be made for variation in type of power or for unusual weather conditions. For example: additional allowance should be made on desert districts where, owing to heat and dust, lubrication costs must of necessity be unusually high. Standard cost for miscellaneous supplies, an item of relative small importance, may be set uniformly for all divisions regardless of conditions as any slight variation in this item would be neglectful in its imperceptible bearing on the cost problem as a whole.

Before attempting to determine a standard cost of service, it would be well to set standards for each of the composing items under the influence of the varying conditions. After this is done the allotment of a standard for any division entails only the determination of the controlling conditions and a simple addition of the standard of the various items corresponding. Any change in conditions demanding an alteration of standard may also in this way be easily taken care of.

Under the prevalent systems of comparison, the man with a low efficiency will bring forth endless excuses why it is impossible for his division to operate as economically or efficiently as others, and without accurate standards comprehending varying conditions, it is next to impossible to discredit his claims, or if his contention of unequal conditions is ignored, it is more than likely that an injustice will be done to one who is delivering the best of service consonant with controlling conditions.

The value of comparison which can be depended upon to reflect the true ratio between the performance of locomotives on various divisions will not be questioned. Standards determined as outlined will give a true and accurate basis for the meting out of praise or censure to the individuals responsible for the various items of performance.

A race between an automobile and a man on a bicycle on equal terms would be devoid of interest. The man depending on his own power would know from the start that victory was impossible and would be possessed of a discouragement which would prevent him from doing even the best that was in him. The man with the automobile would be so certain of victory that he would exert no special effort. Introduce into the race a handicap, giving each man a task commensurate with his powers, and at once you arouse the spirit of rivalry so necesasry to the breaking of records.

The race between the man and the machine is different only in degree from the strife for supremacy in any other line. Given equitable standards, handicapping divisions according to the conditions affecting their operations, a spirit of rivalry and competition will be aroused which will better the performance of all, while the discouraging feature of trying to compete with others more favored and less hampered will be eliminated.

Any one who has tried to argue from the point of efficiency will realize that the mere statement that the per cent of efficiency has been increased or decreased will in the aggregate carry but little weight. What the stockholder or director of a railroad wants to know is, what saving or loss in actual dollars and cents has resulted? In order then to establish a correlation between efficiency per cent and dollars and cents, let us take a few concrete examples to show just what an increase ratio of performance means in the ultimate cost.

A division has an assignment of one hundred locomotives, the average earnings of which have been $150 per day. The service ratio has been 30 per cent, which, compared with a standard of 40 per cent, showed an efficiency of 75 per cent. An increase of business is handled without additional power, raising the service ratio to 32 per cent or 80 per cent efficeincy. This increase in service efficiency means an increase in average earnings per locomotive proportional to the increased efficiency. To determine the earnings per locomotive at the new service ratio we have the equation:

Present earnings: past earnings:: present service efficiency: past service efficiency

$$\text{or present earnings} = \frac{\$150 \times 80}{75} = \$160.$$

This shows that by increasing the efficiency of service 5 per cent the average earnings per locomotive were increased $10 per day, or $1,000 per day increase in gross revenue for the total power assigned.

These figures assume, of course, that the improvement in service ratio was accomplished without lowering the efficiency of speed, load or cost.

Substituting either speed or load efficiency in the foregoing equation for that of service and the results would remain the same.

Any increase in cost efficiency would not evince itself as an increase in gross earnings, but as a decrease in operation expense and a corresponding increase in net earnings. For example: let us say that a certain division handling eighty million gross ton miles per month increased its cost efficiency from 80 per cent to 90 per cent, assuming that the cost per thousand gross ton miles at 80 per cent efficiency was 25 cents, the cost on a like basis at 90 per cent would be 22.22 cents. The total operating cost, which at 80 per cent was $20,000, would be reduced at 90 per cent to $17,776, or a saving for the month of $2,224, which also represents the increase in net earnings.

SONG OF THE SHOP.

The Drawing Room! The Drawing Room!
It's enough to make one curse and fume;
There's something missing on our sheet;
The reach rod ends,—they will not meet,
He's dropped a line, some lazy loon,
That works up in the Drawing Room.

The Drawing Room! The Drawing Room!
There troubles rise and errors loom.
I want a print; I want a card;
I want a sketch and want it hard;
But let it go—we'll be immune;
We'll charge it to the Drawing Room.

The Drawing Room! The Drawing Room!
And always it's the same old tune.
If it wasn't serious, 'twould be a joke
To put on guides without a yoke.
We'll stand round, with an air of gloom
Till they send us one from the Drawing Room.

The Drawing Room! The Drawing Room!
Where errors thrive until they bloom.
If a piece ' short, if a piece is long,
If any old thing is going wrong,
You'll hear us wail till the crack of doom;
The Drawing Room! The Drawing Room!

E. M. C. in *"Loco."*

CANADIAN RAILWAY STATISTICS.

From a report made by John Lambert Payne, comptroller of railway statistics for Canada, the following interesting information is obtained:

"The total track mileage is 25,400, an increase of 669 miles. At the end of June last the period covered by the report, 7,000 miles of road were under construction, of which 1,578 miles were in actual operation, though not formally declared so by the railway commission. In the year $118,391,514 was added to capital liability of railways, of which $61,650,300 was in stocks and $56,741,214 in funded debt. The capital liability is $1,528,689,201, or $55,821 per mile.

"Passengers carried totaled 37,097,718, an increase of 1,203,143, while freight totaled 79,884,282 tons, an increase of 5,401,416. From all sources gross earnings were $188,733,494, an increase of $14,777,277 over 1910. Operating expenses aggregated $131,034,785, making the net earnings $57,698,709, as against $53,557,776 in 1910. A total of 4,219 locomotives, 4,513 passenger cars, and 127,158 freight cars were in service during the year.

"Fatal accidents numbered 493, while 3,300 persons were injured, a decrease of 120 in fatal and 1,190 in other accidents. Of the total of those killed 202 were employees, while of the total injured 1,314 were so engaged. One passenger in every 1,324,919, therefore, was killed, and one in every 124,489 injured. Level crossings caused 36 persons to be killed and 108 injured.

"Employees in 1911 aggregated 141,224, an increase of 17,456. In wages $74,613,318 was paid out, an increase of $7,495,945."

DENVER INTERCHANGE.

The railways of Denver, Colo., have formed a "Joint Car Interchange and Inspection Bureau." This bureau has been placed under the management of Wm. Hansen, Denver, Colo.

STEEL WHEELS.*

By Chas. G. Bacon, Jr.

One of the features of the situation which has been of great interest during the past few years, since the solid steel wheel outgrew the infant class, passed the experimental stage, and joined the ranks of full-fledged necessities, has been, and is to-day, the item of standard designs, and so closely interwoven with this item is that of specifications that it is well to consider them almost as one.

The wheel committee of the Master Car Builders' Association was instructed by the executive committee, shortly after the convention at Atlantic City, last June, to consider these items of design and specifications, and to report thereon at the convention to be held this coming June. I do not believe that I am divulging any confidence when I state that the wheel committee held a meeting somewhat over two months ago at which were present, by invitation, representatives of the solid steel wheel manufacturers, in the hope that they would assist the committee in its arduous work. This, in my opinion, was a splendid move in the right direction. The interests of manufacturers and railways are identical.

Upon learning that the subject of specifications covering solid steel wheels had been under consideration for upwards of two years by a special committee of the American Society for Testing Materials, the M. C. B. wheel committee very promptly, and wisely, determined to accept an invitation which was extended, to have representation on the A. S. T. M. committee. This latter committee is certainly well qualified and privileged to handle this important item intelligently—being composed of representatives of the manufacturers and of the railways which have had the longest and most extensive experience with solid steel wheels. It is not to be expected, in an important matter of this kind, that results obtained will, in detail, meet the ideas, wishes, or even requirements perhaps, of all. There are too many conflicting interests to be reconciled—too many points on which there may be honest differences of opinion—and, on some points, too, little data available, to render results as actually ideal—yet it is a decided step in the right direction, and will give a standard, or recognized basis to work upon, which can be amended and developed from time to time in future so as to serve the greatest good of the greatest number.

As regards the question of designs, it is but proper that the question be thrown open to all, so that there may be full expression of opinion, and so that manufacturers and railways will reach agreements, or standards, at the earliest possible moment. It is, then, the object of this paper to lay before you a list of twenty-one designs of solid steel wheels which long experience and careful study would seem to indicate are adequate standards in connection with more than ninety per cent of the requirements of the railways of the United States today, and which would soon cover the other ten per cent if railroads would give attention to some points in connection with co-ordinate equipment,—and to further lay before you certain reasons why study of the subject has convinced me that a total of eleven of these designs are all that are desirable or required. I ask the fullest possible consideration of the designs which form a part of this paper—I ask railway officials to carefully compare them with their present drawings, with the idea of noting differences (if any)—and I believe that a full and free discussion, therefore, cannot fail to be of great mutual advantage.

Styles 1 to 8, inclusive, are types of wheels for engine trucks.

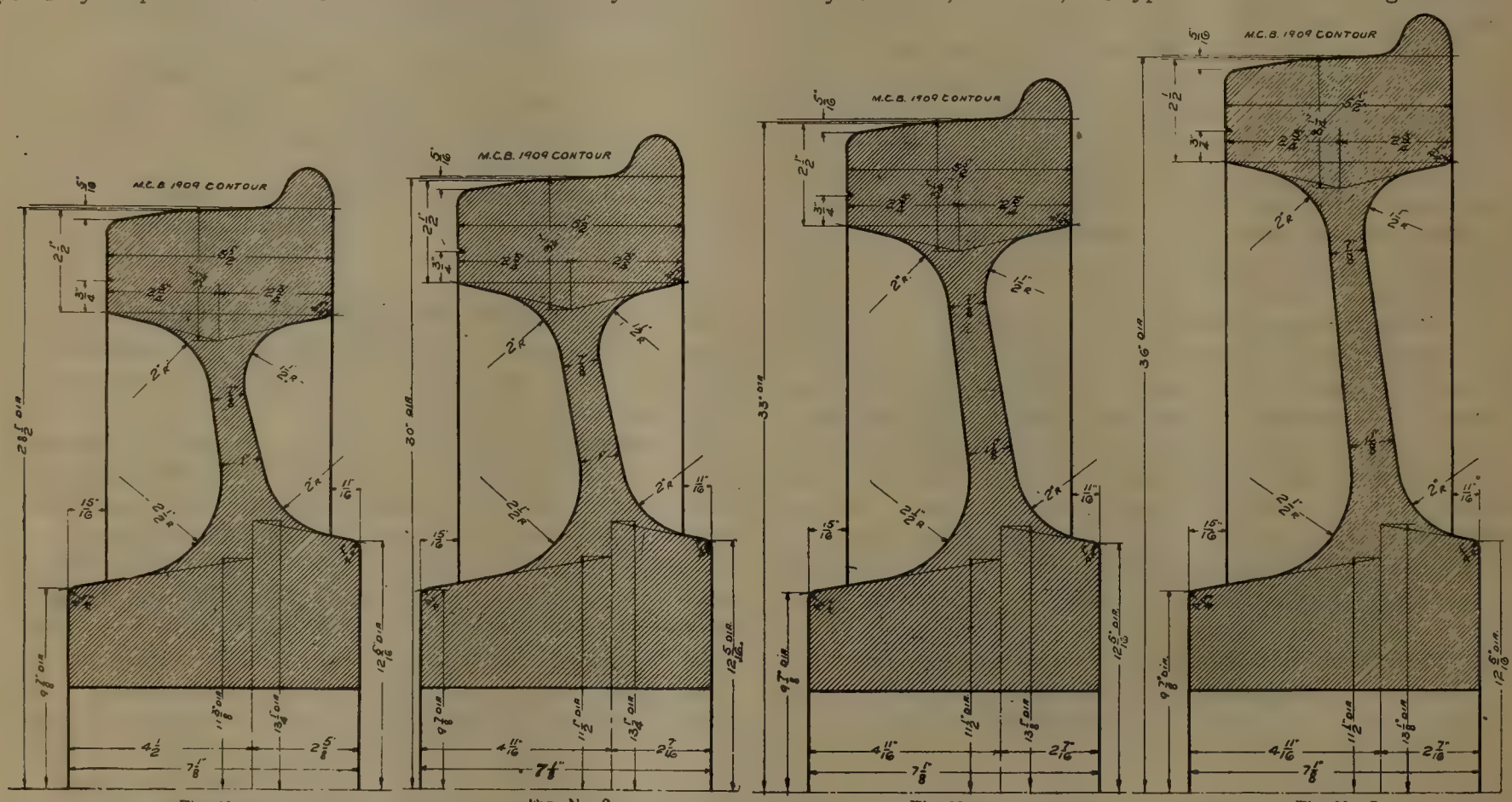


Fig. No. 1 Fig. No. 2 Fig. No. 4 Fig. No. 7

Engine Truck Wheel Types.

and styles 9 to 21, inclusive, are types for freight cars, tenders, and passenger train cars—the salient point of difference between these two general classes being that wheels for engine trucks require inside hub faces of large diameter in order to provide adequate bearing surface as against journal boxes.

The total of eleven designs which I think are all that are desirable and required, are—

ENGINE TRUCKS.

Fig. 1—28½ ins. diameter.
Fig. 2—30 ins. diameter.
Fig. 4—33 ins. diameter.
Fig. 7—36 ins. diameter.

FREIGHT CARS—TENDERS—PASSENGER TRAIN CARS.

Fig. 9—28 ins. diameter.
Fig. 10—30 ins. diameter.
Fig. 13—33 ins. diameter.
Fig. 15—33 ins. diameter.

*From a paper before the Western Railway Club, Chicago, Feb. 20, 1912.

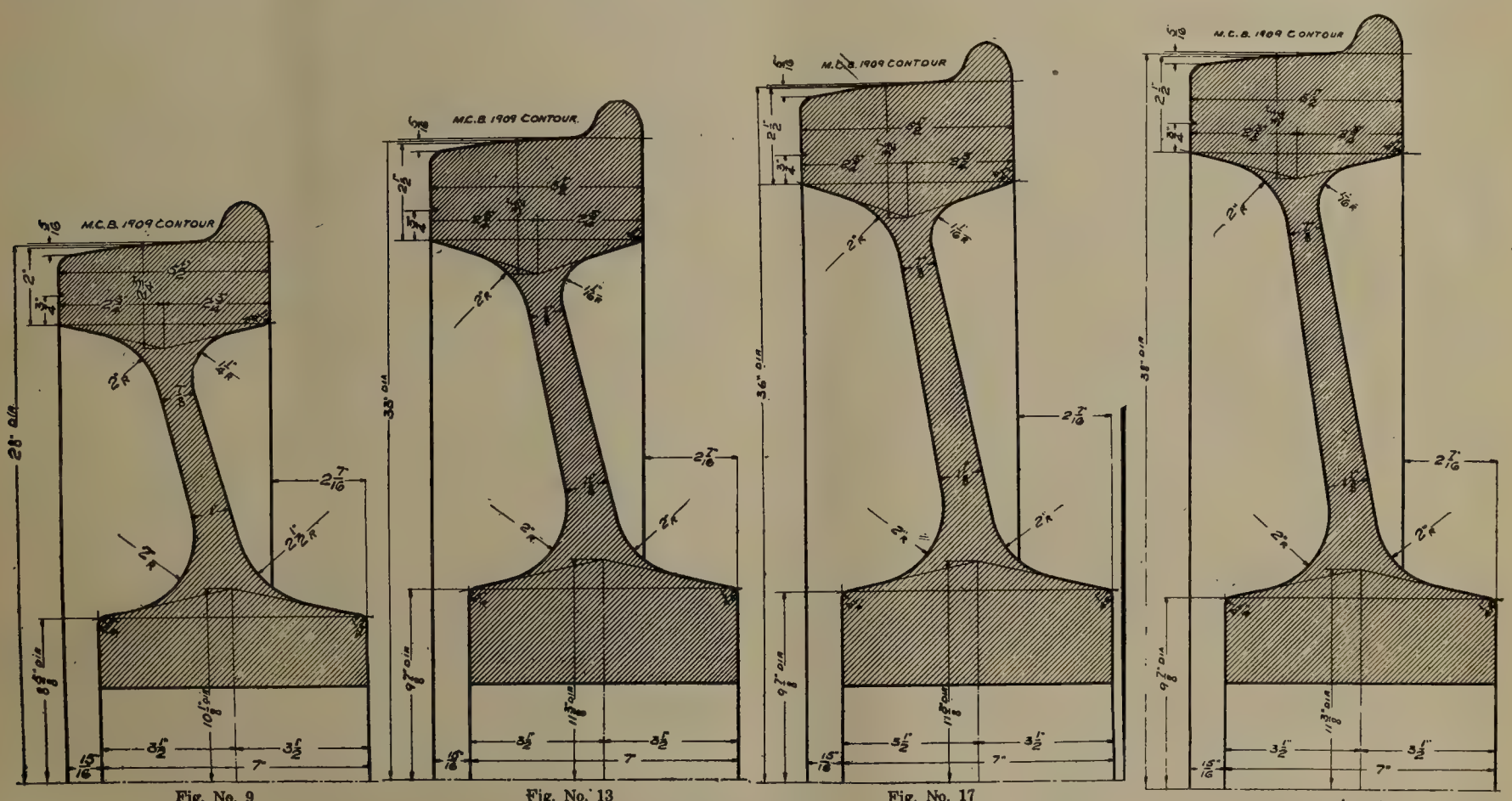
Fig. 17—36 ins. diameter.
Fig. 19—36 ins. diameter.
Fig. 21—38 ins. diameter.

One of the reasons which enters in to increase the number of designs of wheels for engine trucks above the four above noted is that of diameter of inside face of hub. It has long been considered and determined by prominent railroads, who have placed many thousands of solid steel wheels in engine truck service, that this dimension should properly be 12 5-16 ins.—but there have recently been several large companies which have called for engine truck wheels with inside hub faces of either 13 ins. or 14 ins., and in fact one large system has issued a sheet setting forth that this dimension shall be either 11 ins., 12 ins., 13 ins., 13½ ins. or 14 ins., under certain conditions. I venture to say that ninety-five per cent of the solid steel wheels which are in engine truck service in the United States today have 12 5-16 in. diameter of inside hub face—this dimension is standard with the roads which have had the longest and most extensive experience with solid steel wheels of this type—I am told that it has proven to be a proper and satisfactory dimension—and I therefore wish that all railroads would agree either upon this diameter of 12 5-16 ins., or at least some one diameter, as being the standard dimension. The cost of manufacturing solid steel wheels, and therefore the price to the railroads, is largely a question of the number of wheels produced per type, and this being the case it seems most important—particularly as regards engine truck wheels, of which the total number required is not sufficiently large to enable manufacturers, even under the best of conditions, to reduce cost of production to the same level as that of the other classes of which larger quantities are used—that specific attention and study should be given to this dimension of inside hub face diameter, so that a standard can be adopted for the best interests of all concerned.

The 33-in. wheel per Fig. 15 differs from the 33-in. wheel per Fig. 13, and the 36 in. wheel per Fig. 19 differs from the 36 in. wheel per Fig. 17, only to the extent required by the adoption of an additional M. C. B. standard axle,—i. e., the 6x11-in. Hub length is necessarily increased from 7 ins. to 7½ ins.,—depression of front face of hub from 15-16 in. to 13-16 in.,—and projection of inside face of hub from 2 7-16 ins. to 3 3-16 ins. Also, and more particularly, hub diameter is increased from 9⅞ ins. to 11 ins., in order to provide due hub wall thickness.

This brings to mind a point which I wish to make one of the principal features of my paper,—i. e., as to what is the proper hub wall thickness for solid steel wheels.

A hub diameter of 9⅞ ins. has long been recognized as all that is required in mounting solid steel wheels upon 4¼x8-in., 5x9-in., or 5½x10-in. axles,—i. e., up to and including 7 in. diameter wheel-seats—for even in connection with 5½x10-in. axle, and allowing for the tolerances for eccentricity provided for in specifications, a 9⅞-in. hub diameter means a minimum hub wall thickness of 1¼ ins. on a 7-in. diameter wheel-seat. During the past few months, and under the leadership of one of our large systems, which, however, is basing its statements and acts upon experience with comparatively few solid steel wheels, there has been quite a move on the part of some railroads (none of those which have had long and extensive experience in the matter, however,) to use wheels with 11-in. hub diameter on 5½x10-in. axles, and even on 5x9-in. axles, on the ground that 1¼ ins. was not sufficient for a minimum hub wall thickness and tended to "loose wheels." From a manufacturer's standpoint I have no reason to take exception to this move. A heavier wheel means a higher price, and so long as a railroad wishes to pay for excess metal I do not know that it is within a manufacturer's province to object. But as one of the engineers who has had to do with the solid steel wheel subject from its infancy, and who is more or less responsible for the determination and advocacy of dimensions, I wish to assume just as definite and positive an attitude on this point as words will permit me to express.



Wheel Types for Tenders, and Freight and Passenger Cars.

I find that one large system, having over 200,000 solid steel wheels in service, has had less than a dozen "loose wheels" in the past six or seven years—despite the fact that 1¼-in. minimum hub wall thickness has been adopted practice, and despite the fact that in the early days of the solid steel wheel industry, when manufacture was not as accurate in some ways as at present, many wheels went into service with 1⅛-in. hub wall thickness. And of still greater interest, perhaps, is the fact that close investigation of each one of these few cases of "loose wheels" developed the fact that the trouble was due, solely and entirely, to improper boring and mounting, in some

detail, and had no reference whatsoever to the wall thickness of the hub of the wheel. From another large system, with upwards of 90,000 solid steel wheels in service, I learn that in six or seven years only three or four cases of "loose wheels" have developed, despite hub wall thickness of 1¼-in. minimum, and that investigation of these few cases showed them to be due to improper boring and mounting, also.

Such being the experience of those whose long and extensive use of solid steel wheels certainly qualifies them to know whereof they speak, and the knowledge of those whose grasp of the wheel subject entitles them to assert, I must say that I look upon it as a piece of undue assumption when a railroad with a limited experience, both in time and in quantity, sets out to be aggressive along a line with which it is unfamiliar—and I want to say, as forcefully as I can, that hub wall thickness of 1¼ ins. is all that is required in connection with properly designed and manufactured solid steel wheels when mounted on axles with wheel-seats up to and including 7 ins. diameter, and to state that those who are troubled by "loose wheels" under such conditions must look to their own shop practices, to their boring-mills, their axle-lathes, and their wheel-presses for the reason, for the wheel is not responsible for the trouble which some may find in this particular.

Though included in the list, I would hope that 33-in. wheel per Fig. 14 and 36-in. wheel per Fig. 18 could be eliminated from consideration as standard designs. There are some roads who, in wishing for something larger than 5½x10-in. axle, have for reasons of their own doubtless, neglected to adopt the M. C. B. standard 6x11-in., and have gone to the use of sort of an "in-between,"—6x10-in.,—which renders it necessary to add these two extra designs of wheels, per Figs. 14 and 18. As I am discussing wheels I do not like to encroach upon another subject, but it seems to me that as much axle trouble is caused by over-heating as by lack of section, and that conditions are not much improved, therefore, by increasing section without proportionate increase in bearing. In other words, is there any great advantage in a 6x10-in. axle over a 5½x10-in. axle,—would not logic dictate, as a step in advance of the 5½x10-in. where necessary, the adoption of the 6x11-in. axle, instead of a mere "in-between?" I refer to this as merely another one of those features which has its effect upon the cost of manufacture, and therefore the price to the railroads, of solid steel wheels—and, in consequence, as one which is deserving of consideration from an economic standpoint.

Another point which I desire shall be one of the principal features of my paper is brought up by the suggestion that, though shown as standard designs in the list submitted, I would like to eliminate 30½-in. engine truck wheel per Fig. 3, 33½-in. engine truck wheel per Fig. 6, 33½-in. wheel per Fig. 16, and 36½-in. wheel per Fig. 20,—and my reason for wishing and hoping to see these designs eliminated is solely and entirely because they mean the use of solid steel wheels with 3-in. rim thickness.

This subject of rim thickness is one which has received much study and attention at my hands for several years and all experience tends to prove that 2½-in. rim thickness in connection with solid steel wheels makes for efficiency and economy, and that the use of 3-in. rim thickness is to be avoided.

There are two ways of looking at this matter—both of which, however, lead to the same result. In the first place—one must consider the rim of a solid steel wheel as being of two general parts, so to speak—(1) the allowable wearing-body, being that depth which can be properly used in service, and (2) the minimum allowable rim thickness, which necessitates removal from service. For example—in a rim thickness of 2½ ins. it may be said that there is 1½ ins. of allowable wearing-body, with 1 in. thickness remaining which calls for removal from service under M. C. B. rules. Going a step further, it must be borne in mind that this 1½ ins. of allowable wearing-body cannot be entirely used in road service. From time to time while the wheel is in service certain deformations of contour will occur, after varying mileages (and with correspondingly varying depths of metal worn from tread), which necessitate removal of the wheel from service, for re-machining to restore due contour (meaning a depth of metal removed from tread, again, in this operation). All conditions are so variable that it is impossible to say definitely what depth of tread is worn off before the first re-machining, then what depth of metal is removed in that re-machining, and so on, during the several periods, you may say, constituting the total depth of allowable wearing-body—but long experience, with general averages on numerous and various railroads, and under varying conditions, enable me to say that the allowable wearing-body in a rim 2½ ins. thick will split-up far more economically than the wearing-body in a 3-in. rim,—or, to put it another way, that, as a general average proposition, a railroad will secure more actual sixteenths of an inch of wearing-body, and fewer sixteenths of an inch of waste metal, in the allowable wearing-body of a 2½-in. rim than in a 3-in. rim. And though this broad statement of fact may seem to over-shoot the mark, and to evoke remonstrance from those who have not given the point specific attention, all I ask is the opportunity for co-operative study with any railroad official of conditions on his own road, and I will be able to clearly demonstrate the correctness of my statement. But, in the second place, to properly meet conditions a solid steel wheel should possess, throughout the depth of its allowable wearing-body, an attrition-resistance equal to that of the rail, and, to obtain this, certain limits must be recognized in rim thickness from a manufacturing standpoint. Not alone must a high degree of attrition-resistance be obtained initially, but it should be maintained, as uniformly as possible, throughout the allowable wearing-body, and this quality is largely secured by the work, and the depth of penetration of the work, which is put upon the rim. I contend that there is no process of manufacture of solid steel wheels known to-day which will produce as good and serviceable a wheel with 3-in. rim thickness as with 2½-in. rim thickness, and I am, furthermore, making a statement based on the records of a good many thousands of wheels which have been worn out in service when I emphasize this by making the statement in another way, i. e., the mileage-life of a solid steel wheel with 2½-in. rim thickness is greater than one with 3-in. rim thickness, all other things being equal. To look at this point in another light. I have always been, and I am to-day, a strong and consistent opponent of the use of the term "shelling" in connection with solid steel wheels. There has been too much of a tendency to call all defects "shelling," owing to either convenience or lack of familiarity with the subject, whereas due and proper analysis would have classed the defect under one of three or four other and more specific headings, which would have enabled the manufacturer to handle the matter far more intelligently and in a manner decidedly more for the benefit of the railroad. "Shelling" may be the easiest thing to think of, or to say, but it is absolutely non-specific under normal conditions in connection with solid steel wheels, and, in ninety-nine cases in a hundred, means nothing at all. It was explained to me, years ago, by an old and prominent cast-iron wheel manufacturer, how the term "shelling" originated, and as I remember it, his explanation was this: The chilled portion in the rim of a cast-iron wheel extends at a right angle to the chill block, and only to a certain depth—this depth being dependent upon the quality of the iron, etc.—the effect being that there is a slight depth of metal with strong resistance, backed with ordinary gray iron of far less resistance, bordering, comparatively speaking, upon sponginess. That when this strong surface metal had been

worn so thin as to be unable to support the service load which was upon it, it would, having but a comparative sponginess or cushion beneath, mash up and fall away in a manner which left the appearance of the outside of an oyster shell, and hence the term "shelling." With this explanation in mind I have always been opposed, as stated, to the use of the term "shelling" as applied to solid steel wheels, for I have believed, and my belief has been based on specific study, that no such condition should exist in properly designed and made solid steel wheels. But I must now go on record as saying that if some railroad officials persist in using wheels with 3-in. rim thickness, or over, and can succeed in inducing manufacturers to supply such types, then I must, though most regretfully, add the term of "shelling" to the liabilities of solid steel wheels, for close observation of many wheels of this type, not confined to any one manufacturer's product, which I have investigated, convinces me that in a properly made solid steel wheel with 2½-in. rim thickness there is good opportunity for knowing what you are getting, whereas with 3-in. rim thickness you cannot be sure of anything, except that there will be a considerable percentage of dissatisfaction and trouble in the results you obtain. Let those who doubt the correctness of my position in this matter take heed of the fact that the railroads who have had the longest and most extensive experience with solid steel wheels have nearly all given up the use of solid steel wheels with 3-in. rim thickness and adopted 2½-in. rim thickness as standard. Let them note the fact that the more a man learns about the solid steel wheel subject the more convinced he becomes that 2½-in. rim thickness gives the best and most economical results, as is pretty well evidenced by the abolishment of the use of 3-in. rims on his road and the substitution therefor of 2½-in. rims by a member of the M. C. B. wheel committee, since he has come to have a more thorough knowledge of the subject, and let any official refer to the records of his own company and see if the facts of the case do not thoroughly verify my statements.

My line of argument must not be construed, however, to mean that a 2-in. rim thickness would be more efficient and economical than a 2½-in. rim thickness. I do not mean that, and I do not believe that. The 2-in. rim thickness does not lend itself to economical division of allowable wearing-body to meet periods of road service, and metal lost in re-machining—neither does it afford the manufacturer full opportunity for his best work. In this question of rim thickness one is not forced to consider extremes and reluctantly adopt a compromise average, in acknowledging that 2½-in. rim thickness is desirable in connection with solid steel wheels—one need only indulge in a bit of self-congratulation that all manufacturing conditions and service requirements unite in identifying 2½-in. rim thickness as both efficient and economical.

One more point, which I desire to make a special feature of my paper, is a word of caution regarding the production of wheels without machine work upon them.

For years I have been an advocate of the idea of producing wheels so true to dimension that machine work was reduced to a minimum, and I doubt if there is any other one man who has introduced as many wheels of this type into service as I have. I am still a firm believer in the theory, but only to the extent to which it can be carried in due justice to the quality of the material produced. Machine work increases cost of production—machine work may oftentimes remove metal of particular service value—yet if the effort to produce material on which machine work is unnecessary opens the door to a product which lacks uniformity, lacks many of the other virtues which it should possess, and borders on the dangerous—then I feel that extreme caution should be used in order that a "penny wise, pound foolish" policy can be avoided. It may be all right enough to produce some of the commodities of life on the basis of tonnage, or general average—probably it is—but in dealing with wheels let us not forget that we are dealing with units, each and every one of which should possess integrity, as otherwise much time will be spent in settling claims for low mileage, in providing for adjustments covering defective material, and, worse yet, in explaining how wrecks occurred.

Uniformity in manufacture is perhaps the feature most to be desired in connection with solid steel wheels. But uniformity of quality should be held as paramount to uniformity of mere dimensions—and when the tendency is to sacrifice uniformity of quality in the effort to obtain uniformity of dimensions, then I believe that the time has come to "stop, look and listen."

The production of proper solid steel wheels does not entail the mere forming of a bulk of steel into the shape of a wheel. It carries with it far greater requirements and responsibilities. Proper production means not alone mere shaping, but, and particularly, the working into shape along such lines as tend to preserve and develop the virtues of the material for the service in which the finished product is to be used, and the doing of this in such a way as assures uniformity of quality as between wheels which are subsequently mated in service. Irregularity of dimensions can be easily overcome by a few pennies worth of machine work, but lack of uniformity in quality is incurable, so to speak, and is sure to assume more or less serious, if not actually dangerous, forms, when the wheels go into service. I speak most feelingly on this point, for it is one with which I have been closely identified for years—it is one which I have seen, over and over again, is of grave importance—and because it is one which should be closely watched and studied by railroad officials.

I again ask, in conclusion, your consideration and criticism of these 21 designs of solid steel wheels which I suggest as standards for the steam railroads of the United States, and I particularly ask both your earnest consideration and thoughtful criticism of the arguments I have advanced for a desire and suggestion that the list be reduced to a total of eleven designs.

Manufacturers of solid steel wheels are particularly accommodating when engaged in close competition for a railroad's order, and it is for that reason that wheels of all sorts and sizes can be obtained. But clear-headed railroad officials certainly realize that the production of small quantities of an endless variety of designs means a higher cost than when a minimum number of designs permits of proportionately larger quantities, and that cost is always reflected in price. They certainly realize that in the heat of close competition a sales department will frequently offer, because the works says under urging that they can produce, "odd" designs which may or may not have been thoroughly demonstrated as unifying the possibilities of proper manufacture and the requirements of service, and they surely appreciate how standardization of wheel designs is an end to which we all should strive.

The Canadian Pacific recently announced that it will spend $600,000 this summer in constructing one unit of the projected terminal plant at Couitlam. The entire terminal is laid out in a system of units, which will be added as traffic increases. The first unit to be constructed consists of a round-house, 25 miles of terminal track, and general repair shops. Eventually there will be five units and 95 miles of terminal track .

The Missouri, Kansas & Texas, it is reported, will begin work on terminal improvements at East Waco, Tex., which will include the construction of shops, roundhouse, turntable and a water-softening plant.

ELECTRIC WELDING.

By J. A. Shaw, Elect. Eng., Can. Pac. Ry.

Welding is one of the most important, and, at the same time, one of the most difficult operations in the manufacture and use of metals. When the operation is performed by hand it is always expensive and frequently inconvenient, and reliable welds are rarely obtained, unless a man of considerable skill is employed.

Little progress has been made during the past 1,000 years in the art of welding by hand, notwithstanding the fact that reliable results are more and more needed as the manufacture of metals and alloys becomes improved, and higher working stresses are demanded.

A perfect weld might be defined as one in which the metal at or near the weld remains equal in strength or ductility to those parts of the metal which have not been heated. In the ordinary process of welding two pieces of iron, the smith heats the ends in a fire until, so far as he is able to judge, the temperature has become somewhat higher than the correct welding temperature. The ends are then placed together, treated with a flux (such as borax), which melts and quickly covers the heated surface, thus preventing the further access of air, and at the same time, reducing the oxide scale already formed to a liquid state, the smith then hammers the two ends together, his aim being to force out from the surfaces in contact all the burnt iron and all the flux, and also to produce a smooth, round surface. The strength of the weld depends almost entirely on the skill which has been exercised in bringing the metal to just the right temperature, and in hammering or squeezing out all the burnt metal and the flux.

The welding of brass, copper, etc., is impracticable by the usual methods; copper would need to be raised to a very high temperature, as compared with iron, and is then highly oxidizable and liable to form a scale difficult to treat by any flux; it also passes quickly from the solid to the molten state and is brittle near the welding temperature; while with brass it is difficult to avoid the volatilization of the zinc before the copper element has been raised to the necessary temperature, and, further, this alloy also becomes exceedingly brittle near the welding temperature.

Hitherto such metals and alloys have been united by brazing or soldering, operations which require considerable skill and are expensive in the matter of solder, fluxes, heating appliances and labor charges. These metals can, however, readily be welded electrically, and under certain conditions, there is no difficulty in making a good weld between two entirely different metals or alloys.

The use of electricity for welding, though introduced some years ago, has not been widely applied until lately, perhaps due to the comparatively large quantities of energy required. However, as electrical welding is capable of producing astonishing results, it is now revolutionizing many manufacturing operations; and although there may have been some disappointing experiences with the process, due chiefly to the injudicious selection of methods and machines for the particular work in hand, it is a fact that perfectly reliable and most satisfactory results can now be obtained, not only in electrically welding iron and mild steel, but also copper, brass, and many other metals and alloys. Highly skilled labor is no longer necessary, the rate of production is greatly increased, the net result being that more reliable work can be turned out at a fraction of the previous cost. The system adopted and the machines employed must, however, be suitable for the particular class of work required to be done.

There are several distinct processes of electric welding in general use, known by the names of the original investigators, or at least, those who had most to do with showing their practical utility, viz: Zerener, La Grange Hoho, Thomson, and Bernados.

In the Zerener method an arc is set up between two pencils of carbon, and the arc caused to be blown in the required direction to impinge on the metal to be welded by an electric magnet. This may be compared to the blowpipe. In this process either direct or alternating current can be used.

The second process, named after a French scientist, is commonly known as the water-pail forge. In this a wood tank is filled with a suitable solution. This method is limited to the use of a direct current. The positive pole of such a source of power must be connected by means of a suitable electrode (metal plate) to the solution. The metal to be worked is connected to the negative pole terminal, then dipped into the fluid until the proper temperature is obtained. Metal is then removed and mechanically welded by the use of hammer and forge.

In the Thomson process, the two pieces of metal to be welded are brought into close contact, and connected into the path or circuit of an alternating current source of power. As the resistance of the circuit at the point of contact is higher than elsewhere in the circuit, heat is immediately generated, and in a very short interval of seconds a welding temperature is reached, the current being then shut off and the two parts forced together under pressure.

In the fourth method a direct current source of power is used to set up an arc between a block or pencil of carbon connected to the negative pole of the generator circuit, and the steel casting or piece of metal to be welded joined to the positive pole.

In the practical application of electricity for commercial welding service, the employment of the Thomson and the Bernados methods are the ones most widely used.

Through the instrumentality of Elihu Thomson, of Lynn, Mass., the process which bears his name, Mr. Weinfeld, of Warren, O., and others, machines having been so developed to automatically carry out the welding process in a manner undreamed of formerly, and by the service of the most unskilled form of labor. Thoroughly sound welds can be made in copper with ease, and it is an important fact that brass can be welded without destroying the structure given to it by rolling or drawing, and the welds will stand all the rolling and drawing process necessary to work the material down to the smaller sizes. Figure 1 shows the system adopted in the construction of a typical welder of the Thomson type. A is an alternating current dynamo which can be connected up by means of switches H and D to the primary coil of a transformer. The secondary coil of this transformer consists of a massive single winding S. S. terminating externally in two massive clamps C.C., which grip the two rods to be welded. When the switches are closed the generator supplies a current of moderate strength, assume 10 amperes, at a pressure of say 100 volts to the primary coil P of the transformer. This current is transformed by electro-magnetic induction into the circuit of low voltage (assume 1 volt), but very great quantity (assume 1,000 amperes) in the secondary coil S, and this heavy current so produced flows across the junction of the two rods, their ends B.B. being held together under pressure. The electrical resistance in the secondary circuit being practically all located at the two end surfaces, thus kept in contact, all the heat is developed at these surfaces, that is to say, just where the weld is required to be made, and the resulting increase in temperature, by further increasing the electrical resistance at this point, adds the desired effect. A device is provided for regulating the pressure between the ends of the rods, since this pressure must be made to suit the size of the rods.

*From a paper read before the Canadian Railway Club.

and the plasticity of the metal at its correct welding temperature. After a few seconds the metal begins to flow and the rods become firmly united and the current is cut off at the switch D. It will be noticed that the heat is generated at the joint and confined there, the energy, therefore, being employed most economically.

An idea of the electrical energy required for operation of such welding machines is given below.

Based on using fairly clean stock, the current and time required in welding different gauges of sheet and rod steel is as follows:

Gauges of Sheet Steel	Thickness in Fractions of an Inch	Approx K.W. Capacity	H.P at Dynamo	Time in Seconds to Weld	K.W. Hrs. for 1000 Welds
10	9-64	18	25	1.5	3½
12	7-64	16	23	1.3	3
14	5-64	14	20	1	2¾
16	1-16	12	18	.9	2½
18	1-20	10	15	.8	2¼
20	3-80	9	14	.7	2
22	1-32	8	13	.6	1¾
24	1-40	7	11	.5	1½
26	3-160	6	9	.4	1¼
28	1-64	5	8	.3	1

Iron or Steel Rod.	Area	Horse Power.	K.W	Seconds.	Approx. K.W Hrs. per 1,000 Welds.
¼	.05	5	4	2	2
⅜	.11	8	6	3	5
½	.20	12	9	6	15
⅝	.31	16	12	10	30
¾	.44	20	15	15	65
⅞	.60	24	18	18	90
1	.79	26	20	20	113
1⅛	.99	33	25	24	167
1¼	1.23	40	30	33	275
1½	1.77	50	38	40	422
1¾	2.41	64	48	48	640
2	3.14	80	60	60	1,000

The time given is for the application of the current only. Multiplying the K.W.Hrs. by the number of cents paid per K.W.Hr. for power gives the current costs per 1,000 welds.

Some of the advantages of welds made in this manner may be briefly enumerated as follows:

1. The structure of the metal at the joint is the same as elsewhere.
2. Absolute control over the heat.

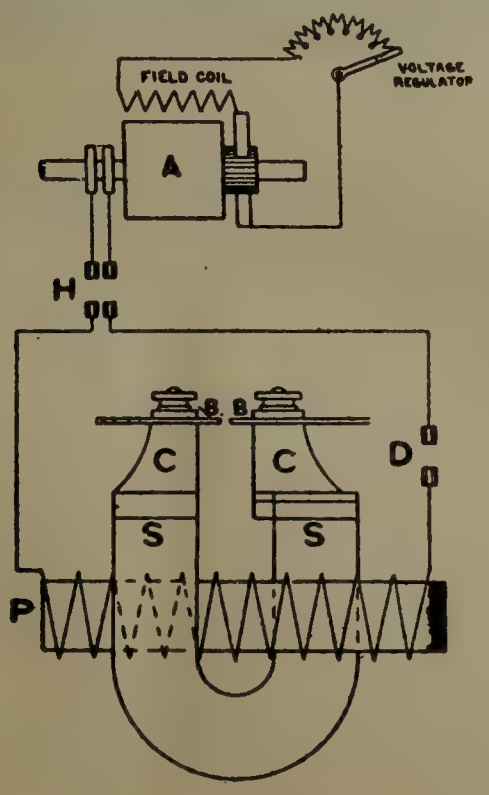


Fig. 1.

3. Localization of the heat at the weld.
4. Welding can be watched throughout.
5. No smoke, heat or dust.
6. Accuracy of work possible.
7. Rapidity.
8. No blistering or scaling, heat travels outward.
9. Impurities thrown out, avoiding flames.
10. No flux required.

One of the most important developments within the last few years has been the progress made in the use of cast steel. It cannot be said, however, that, for general purposes, steel castings have been as reliable as iron castings. No matter how much care is taken in the preparation of moulds, and in the general foundry practise, blow holes or other defects have resulted in a comparatively high percentage of scrap with steel. By the use of the Bernados process of electric welding a means is now available for the repairing of defective steel castings. The usual equipment used for the purpose consists of an outfit as shown in figure No.

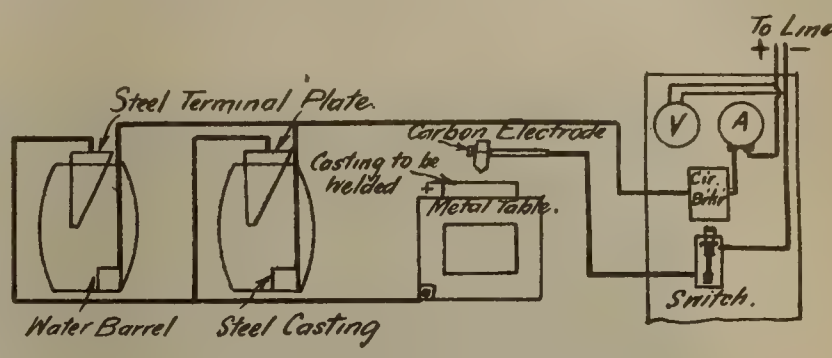


Fig. 2—Diagram of Connections.

2. This consists of a direct current source of supply, a rheostat, a carbon electrode and fire clay or carbon blocks for moulding purposes. An enclosure has to be provided to carry out operations, for the glare of the arc is very intense and would seriously interfere with any other work in the immediate vicinity. The operator requires to have all parts of his body well covered, as a very few moments exposure to the rays will produce an irritating effect like sunburn upon the skin, resulting in uncomfortable consequences. For the head a canvas hood is generally used, being fitted with a small window of colored glass, through which the welding operation may be watched without risk of injury to the eyes. The hands should be protected by heavy leather gloves provided with gauntlets to cover the wrists. Current from a 100-volt dynamo is the most suitable. A satisfactory rheostat is obtained by using two barrels of water, in which are suspended plates moveable by means of ropes carried by overhead pulleys. In the general repair of steel castings an iron rod of about ⅜ in. diameter is used for filling, although smaller pellets from scrap boiler plates or steel castings may also be used. In making a weld the positive terminal of the circuit is clamped directly to the casting to be welded. The positive terminal is thus connected instead of the negative terminal, so as to direct the flow of current from the casting to the carbon electrode, and in this way prevent carbon from entering the weld. As soon as an arc is sprung the carbon is withdrawn to a distance of 2 in. or more (too short an arc will tend to produce a hard weld), and the arc allowed to play upon the casting until the metal begins to boil. The end of one of the iron rods is placed directly in the boiling metal where it melts and mixes. As the rod melts away it is fed into the weld until the latter is completed. The surface of the weld may be hammered as it cools.

Should the part of the casting to be welded present a dirty appearance or contain slag, it should first be cleaned by means of a chisel or by the arc. In the latter case, this is accomplished by tilting the casting so as to allow the slag or dirt to drop off as fast as it melts when the arc is applied.

After cleaning in this manner the casting is then tilted back and the welding proceeded with.

If possible, the weld should be made with one continuous application of the arc without allowing the casting to cool off. The reason for this is that oxide of iron (scale) will form with each cooling, and, if not removed, will assist in producing a very hard weld, that is, one not easily machined. Where, however, it is not possible to make the weld with one application of the arc, the scale should be brushed off by means of a stiff wire brush. Hammering the weld after cooling will also very materially assist in this cleaning.

When, instead of a cavity to be filled, it is necessary to build up a lug or to weld a piece to the casting, fire-clay or carbon blocks may be used for the purpose of confining the molten metal within certain desired limits, or of having it assume a definite shape. The carbon blocks are generally worn-out dynamo and motor brushes, and while they can sometimes be used without further dressing, being built up around the space to be filled by the metal, they frequently require cutting to shape with a knife. When fire-clay is used it is formed to shape by the hand.

When the work is properly done, welds made by this method will give an average tensile strength equal to 70 or more per cent of the original stock.

Besides the welding of steel castings the Bernados process may be advantageously employed in the removal of surplus metal, including sink heads, in the boring of large holes in castings or plates, in the welding of flanges, elbows and couplings to pipes, and in a variety of other ways. It will be found, for example, that surplus metal and sink heads can in many cases be removed from castings in much less than the time required when a cold saw is used, the arc not only doing the work quicker, but there being practically no time lost in setting the casting in position; the same reasons apply to the boring of holes by the arc instead of by a drill.

In conclusion, it may be stated that the Bernados process will give thoroughly satisfactory results commercially, it is one which can easily be learned by any workman of average ability, and only a few weeks' practise will be necessary in so doing. The welds first made will generally be harder to machine than the other portions of the casting, but where no machining is required, this will not prove detrimental; increasing familiarity with the process will, however, reduce the number of such hard welds to a minimum.

The ability to employ the almost unlimited knowledge of electricity quickly to raise the temperature of a joint to be welded, delivering the heat exactly where needed, and limiting it largely to this spot; the advisability of reaching a temperature which cannot be obtained without difficulty, if at all, by ordinary process; the ability to graduate the amount of heat developed with so much control; all these cannot fail to open a wide field for the use of the art in every department of industry in which metals are employed.

GERMAN PORTABLE SAND BLAST.

A portable sand blast installation is frequently desirable for use in different places and a unique electrically driven sand blast outfit is shown in the accompanying illustration.

German Portable Sand Blast.

It was designed and constructed at Ottensen near Hamburg, Germany, by the Alfred Gutmann Actiengesellschaft. This apparatus is well suited for use in shop yards where either direct or alternating current is available. The compressor is mounted on a truck and is driven by a small electric motor installed on the same base with the necessary starting box and controlling switches.

It will be noted that the sand blast apparatus as well as the air tanks are portable and may be located near the work to be done. The sand blast equipment can be removed from the car and placed on the floor in any working position desired, it being connected to the air tank by a high pressure flexible pipe or armored hose.

Van Slant & Houghton, Hooker & Lent Bldg., San Francisco, have started work on the A. T. & S. F. roundhouse at Riverbank. This is a reinforced concrete structure built according to patented "Unit-Bilt" methods of the Unit Construction Co., St. Louis, for whom Van Sant-Houghton Co. are Pacific Coast representatives.

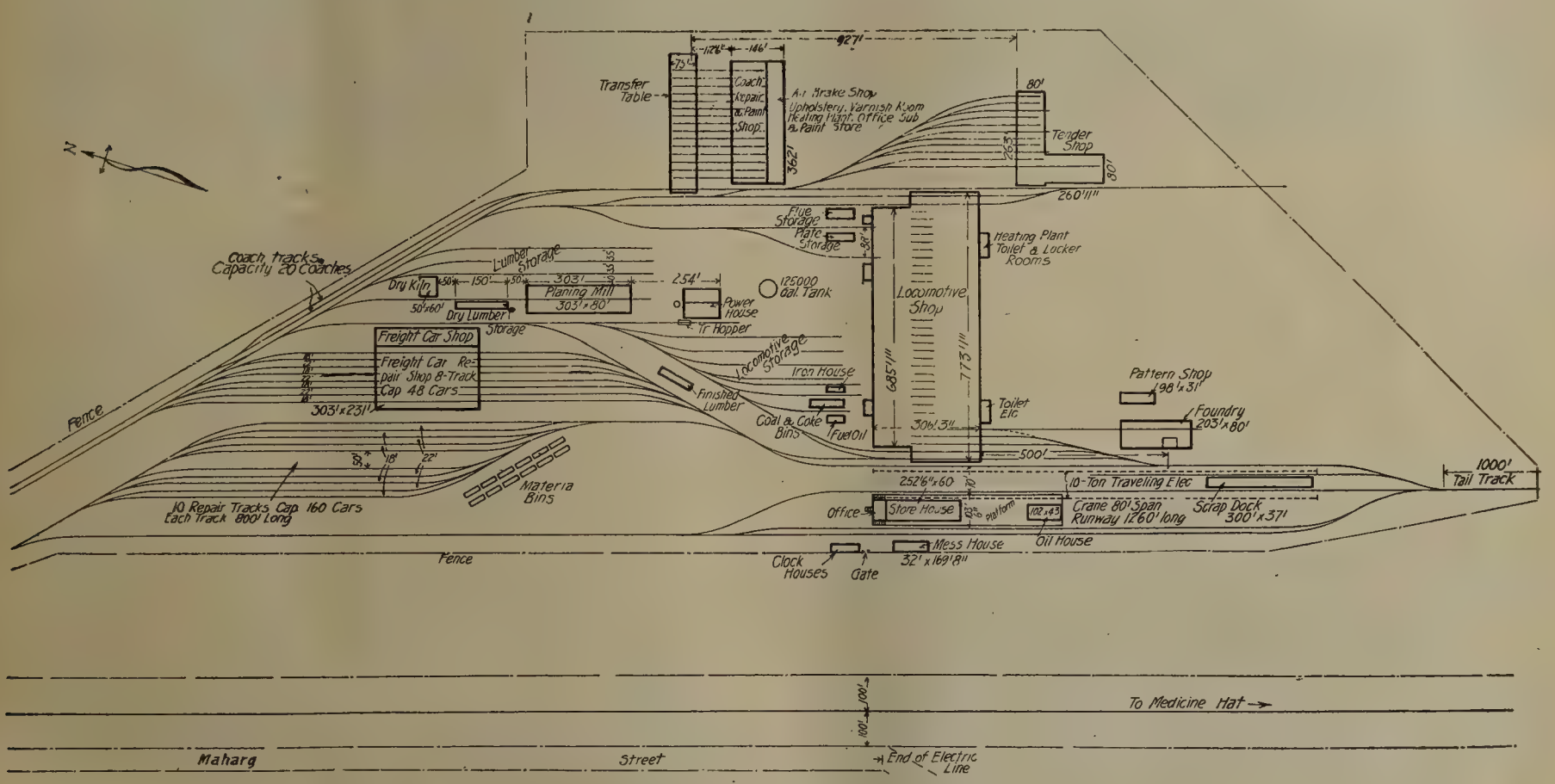
CALGARY SHOPS, C. P. R.

The Canadian Pacific Ry. has retained Westinghouse, Church, Kerr & Co. as engineers and constructors for its new western shops, which are to be built near the present shops at Calgary, Alberta, Canada. The work includes the design and construction of shops comprising locomotive erecting shop, machine shop, blacksmith shop, boiler shop, tender shop, foundry, planing mill, power house, pattern shop, coach repair and paint shop, freight car repair shop, storeroom and office building, oil house and numerous smaller buildings and structures such as mess building, dry kiln, scrap docks and material bins. The general layout is shown in the illustration.

The main shop building will be 712 feet by 306 feet in size and will contain the erecting, machine, blacksmith and boiler shop. The building will be heated by the indirect fan system. The erecting shop will be of the transverse lift-over type and will contain 35 bays of 22 feet each. The machine shop for heavy machine tools will be located parallel to and adjoining the erecting shop on one side and space will be provided alongside of this shop for another machine shop to contain lighter tools. The blacksmith shop will be located parallel to and adjoining the erecting shop, but on the opposite side to the machine shop, and will afford ample space for heavy forging work, steam hammers, etc. Adjoining the end of the blacksmith shop and parallel to the erecting shop will be the boiler shop, next to the high bay of which space is provided for flue shop, boiler shop tools and a flue rattler. In general the construction will be concrete, steel, brick or hollow tile, depending on conditions as yet undetermined.

The foundry will be 80 by 204 feet and will have two bays, the higher of which will be served by an electric crane. This crane will also be used to transfer jib cranes, which can be attached to any of the building columns. The cupolas and charging floors will be at the center of the side bay and core making and snap moulding will also be done in the side bay. The tender and wheel shop is to be an L-shaped building 80x340 feet and will be supplied with an electric crane. The building for the repair of freight cars will be 300 by 231 feet in size, with a saw-tooth roof, and will be adjacent to the lumber yard. There will be eight repair tracks, with a material track between every other one, and one side will be partitioned off into a shop for the forge and woodworking tools. Near this building will be the planing mill, a building 300 by 80 feet with a track through the center. The dry kiln is located nearby. The coach repair and paint shop is 362x146 feet, with 15 tracks at 24-foot centers, and will be served with a 75-foot transfer table. Near one end of the locomotive shop will be the office building and storehouse, 250x60 feet. The office end will be three stories high, the remainder two stories. A 10-ton crane will cover the span between the storehouse and the locomotive shop. Near one end of the storehouse will be the oil house, 42x102 feet in size. The power house will be 84x104 feet and will be equipped with overhead bunkers and a dumping pit for transferring coal to them.

The work of the contractors will include the design and installation of the service equipment in the various buildings, including traveling and jib cranes, wiring systems for shop and yard lighting and power, air and steam piping systems for power and heating purposes, water supply for drinking and fire protection, plumbing and toilet facilities, drainage system, transfer tables and pits, coal and ash-handling equipment, necessary switchboard and transformer sub-stations. J. G. Sullivan, chief engineer Canadian Pacific Railway Co., Western Lines, is in charge of the work. The cost will be about $2,500,000, and it is expected that the shop will be completed by the end of the year.

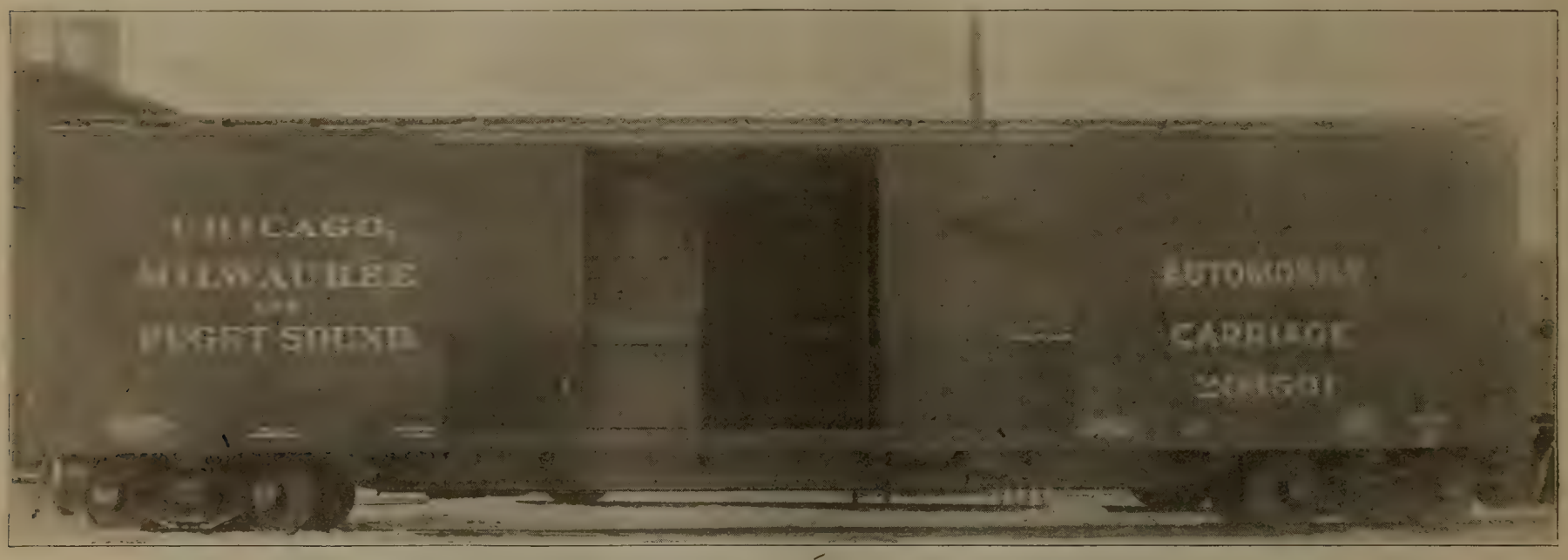


General Layout of Calgary Shops.

"There is nothing new under the sun" is one of the old sayings which we hear very frequently. However, nothing is so old but what there is always an opportunity for somebody to look at it from a new viewpoint. Innumerable men had seen steam rising from pots and kettles; one man saw in the steam, energy. Since the beginning of the world, people had seen lightning in the heavens; one man saw in it, power. In the early days of railroading, hand brakes and the compression of air were both familiar to many, but Westinghouse saw the opportunity to combine the two into the air brake. Did you ever stop to think that every device and every machine about you is the product of some man's brain? How many things, however small, can you see that were developed in your brain? The only thing new under the sun is a man's mind.

Automobile Cars for C. M. & St. P. Ry.

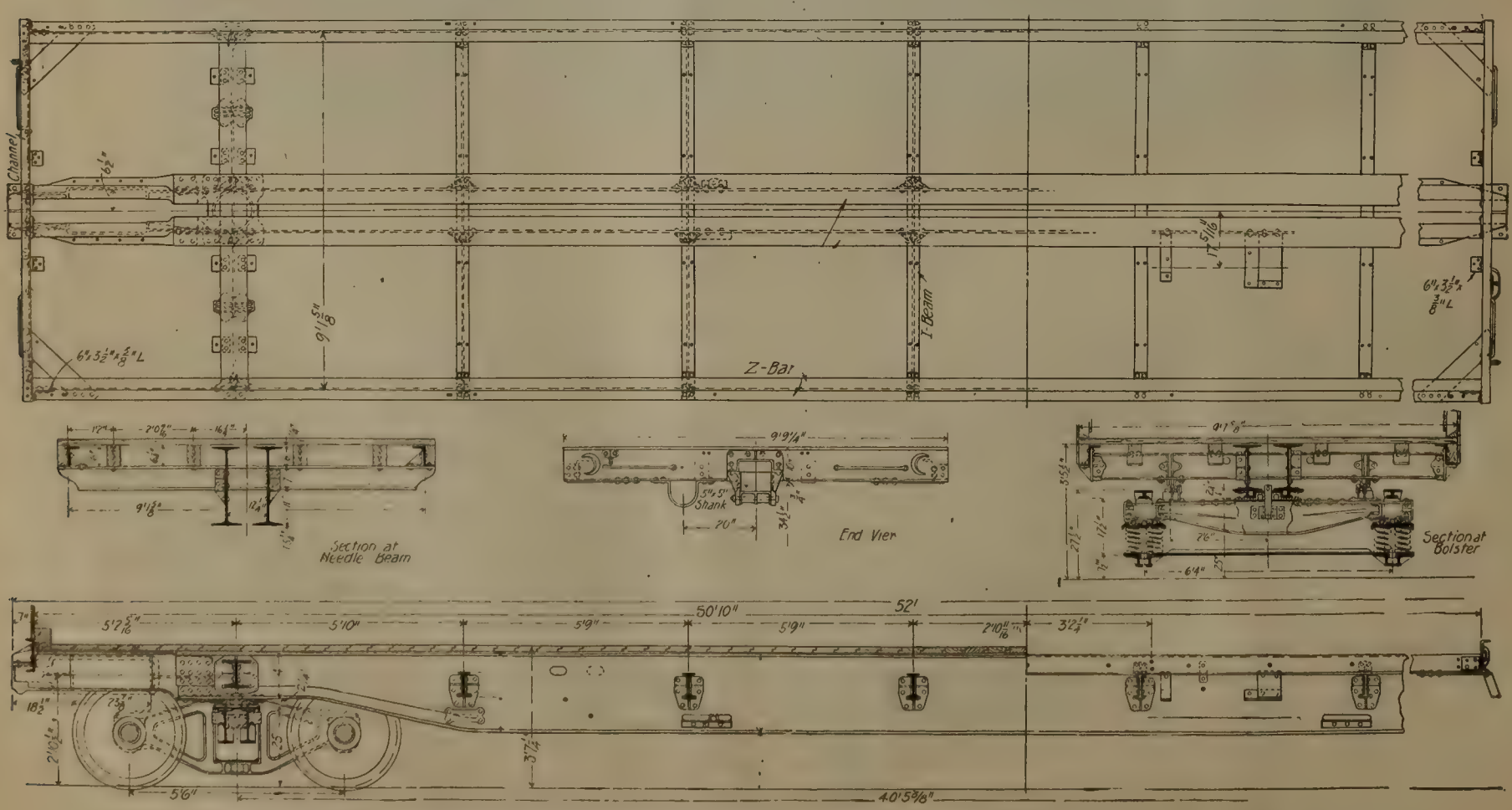
The Milwaukee shops of the Chicago, Milwaukee & St. Paul Ry. are at present busy on an order of 470 automobile and carriage cars for use on both the St. Paul and the Puget Sound. These cars have a capacity of 4,675 cubic feet, or 80,000 pounds, are 50 feet in length inside, 9 feet wide and the height from floor to carline at the center is 10 feet 6¾ inches. The extreme length of the car over siding is 50 feet 10 13/16 inches, the height from rail to top of running board



One of Large Order of Automobile Cars Built at Milwaukee Shops.

is 14 feet 10 inches, and the width of car over roof is 10 feet ¼ inch. They are equipped with Miner friction draft gear and M. C. B. pocket coupler. The Bettendorf structural steel underframes having double center sills composed of two "I" beams, are specified on the entire order. The side sills are of "Z" bars. The "H" beam body bolster is continuous from side to side of the car. The needle beams are also continuous from side to side of the car. The center sill ends are of annealed cast steel having draft lugs cast integral. The Bettendorf cast steel boltless truck is used on the entire order. Grip nuts are used on a part of this order.

A notable feature is the arrangement of the side doors which are of different sizes and are respectively 4 feet 8⅞ inches and 6 feet 7½ inches in width. The doors on either side of the car are staggered so that the two large doors are opposite each other. A hinge lock on the upper sill is used to hold the smaller door closed when shipments will go through the large door. Z bar tracks are provided and the clear opening between both doors is 10 feet. The arrangement of these doors, together with the framing, is clearly shown in the photographic reproduction and the elevation drawing. Details of door post and guides are also shown in another sketch. One end of the car is equipped with double swinging doors which are held in place by 1¾ inch by 6 inch bull bar and have a clear opening of 8 feet 6 inches. Both sides and end doors are supplied with Unoit door locks. Posts and diagonal braces are 3 inches by 5 inches, and are of white oak, as are also the end sills, end



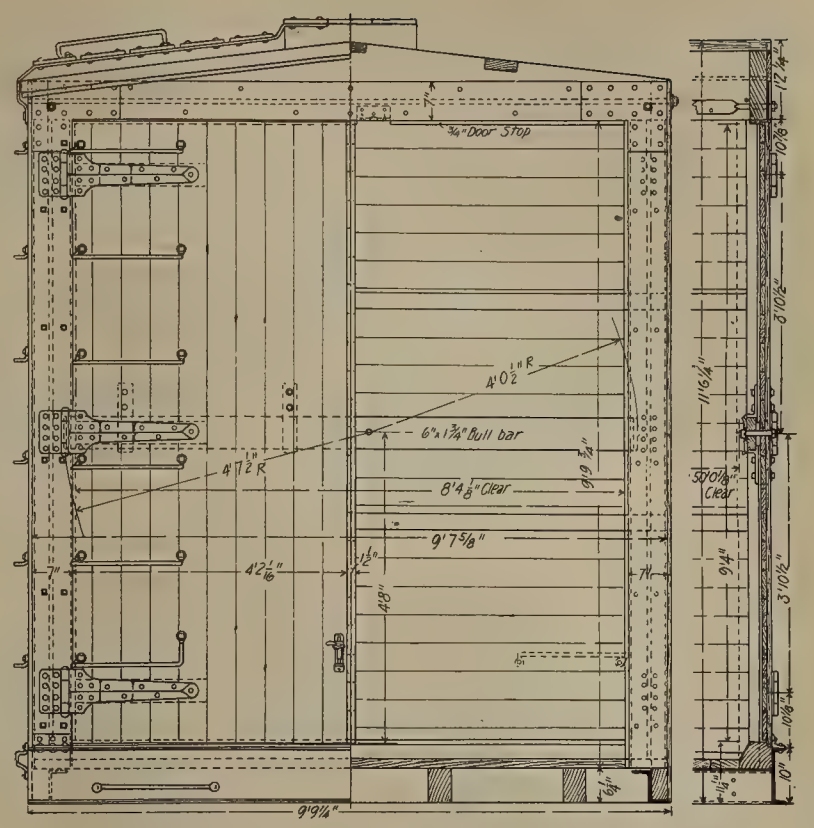
Plan and Elevation, with Details, of Bettendorf Underframe Used on Automobile Cars, C. M. & St. P. Ry.

and corner posts. Thirteen-sixteenths inch sheathing is used on both the outside and inside. One and three-fourths inch material is used in the flooring.

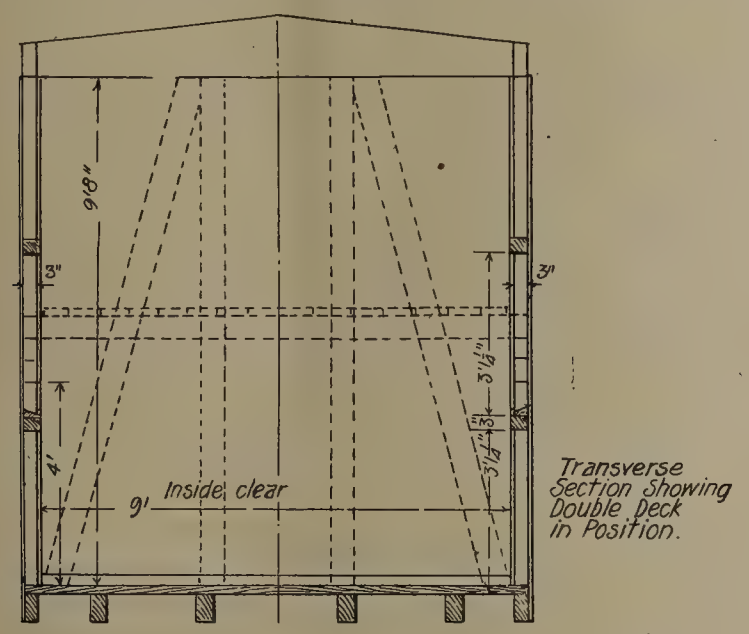
The cars are arranged for double decking, details of which are shown in the figure shown herewith. The height, from the floor, of the post for double decking is 4 feet and by inserting blocking 2¾ inches by 5¼ inches by 6 inches, or less, the cross beams can be brought to the required height At the side doors, two 3 inch x 5½ inch posts are to be put in by the shipper when the car is to be used with double deck.

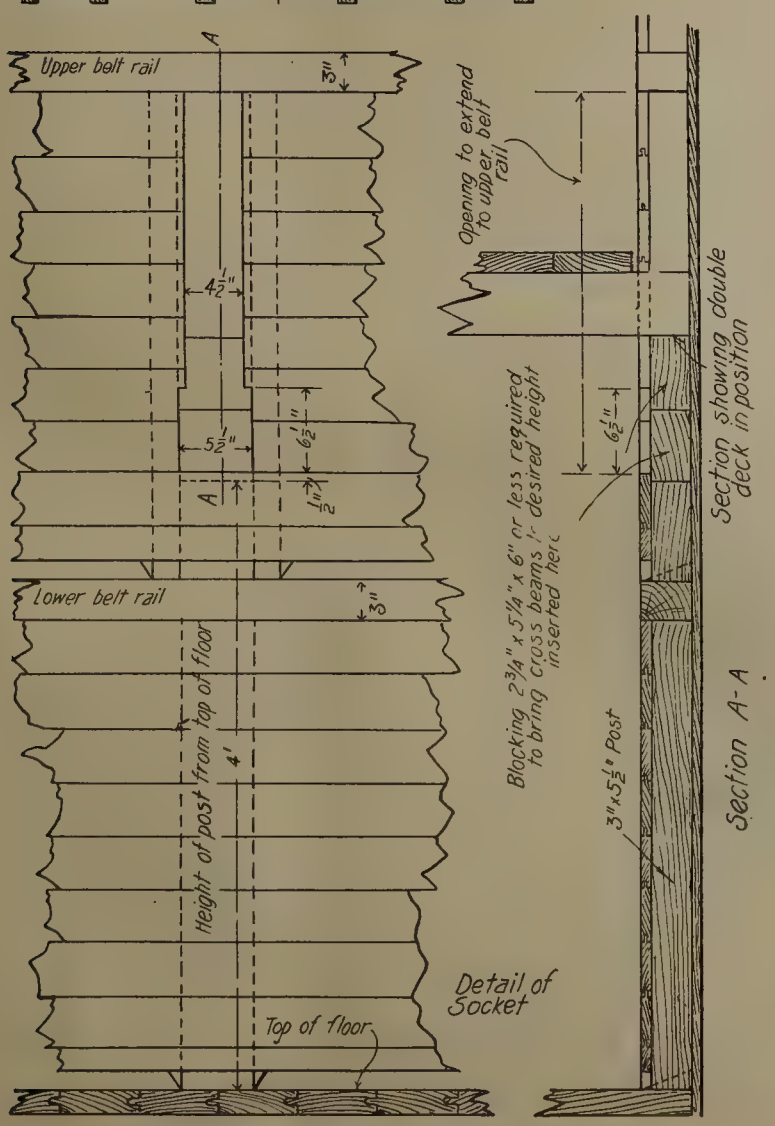
USE AND ABUSE OF INSPECTION.

It has been remarked that society in these days is rapidly becoming divided into two classes—the inspectors and the inspected. Engineers especially realize that there is a great amount of truth in this saying, as few orders are placed nowadays for engineering plant or materials which do not stipulate for inspection. This tends to become stricter every year, owing to various reasons, the chief being that manufacturers, in selling their goods are now generally bound down both in price and time of delivery, the former being so low and the latter so short that mistakes are more liable to occur than was the case in the old days, when the manufacturer could ask and obtain his own price and could take his own time. In those days the buyer often had to take what the manufacturer gave him, and was glad to get it at almost any price. But now the buyer knows quite well in most cases what he wants, what price he ought to give, and exactly what he ought to get for that price, and his main object is to see that he gets it. It follows therefore, that buyers have come to the conclusion that their interests



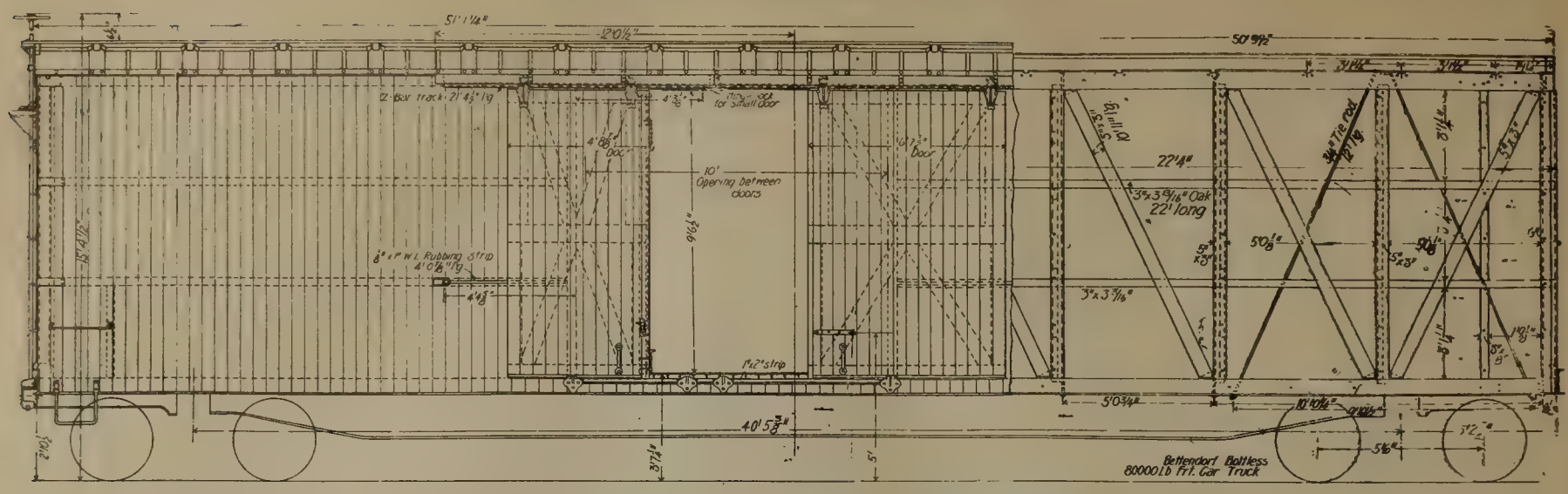
End View Automobile Car, C. M. & St. P. Ry.





Details of Double Decking Arrangement.

Interior of Automobile Car, showing Carlines.



Side Elevation Automobile Car, C. M. & St. P. Ry.

will be best served by employing inspectors empowered to visit the works of the contractors at all reasonable times, without notice, and to follow the course of the order through the works, testing the materials and the finished work, and checking quantities, weights, etc.

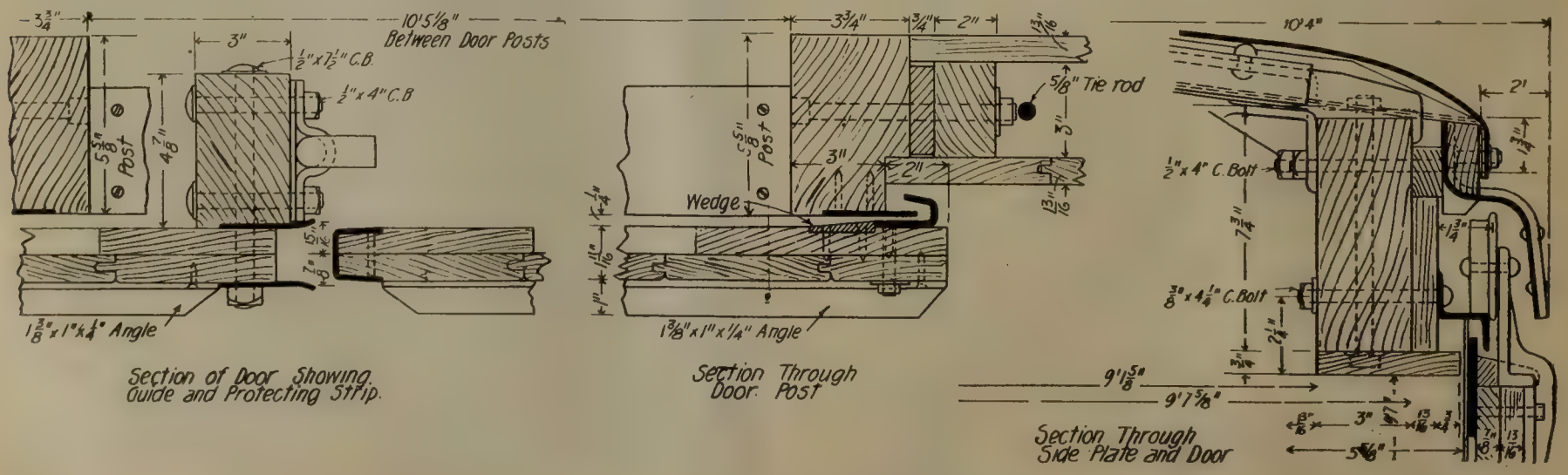
The knowledge that the inspector may visit them at any time has a good effect upon contractors in keeping them up to the mark, both in quality and time. This effect is an all-round one and to other than inspected work, as manufacturers know very well that when they are constantly having inspectors in the works it is not desirable to have too much second-rate work lying about. Inspectors do not judge a works entirely by the quality they get themselves, and their opinion carries considerable weight. The very fact, therefore, that a number of buyers send inspectors to any one works makes that works a more reliable place for other buyers, who do not employ inspectors, as the frequent presence of inspectors has a good effect on the general quality of the work turned out of any manufactory.

There is, of course, no attempt on the part of firms of good standing deliberately to defraud their customers. But at the same time manufacturers cannot afford to do more than keep to the bare specification, and specifications are often interpreted differently by buyers and sellers. Then, again, the heads of a firm cannot always attend to every detail, and foremen and workmen will often scrimp work, either because they are on piecework, or merely to save themselves trouble. In the matter of loose rivets in steel-work, blowholes in cast-iron pipes, and such-like, small but important defects, the inspector cannot lay the blame on the manager or foreman unless the flaws are numerous. But it is his business to find these flaws out, and if he discovers a number and sees them put right in the early stages of an order, he will find that the workmen will take more care afterwards. Again, mistakes are frequently made in dimensions, and many firms have no systems of checking their finished products, even when the matter is left in their hands.

A good inspector, dealing with large quantities of materials, will save his employers many times his salary in the course of a year. But, to gain the full benefits of inspection, a good man must be engaged. An inspector cannot be an expert in everything, but he must have a very clear idea of the difference between good and bad work, and must be able to read drawings easily. Then an inspector must be firm and able to hold his own, but at the same time tactful, and his honesty must be above suspicion.

An inspector with the above qualifications, and who is also the equal socially of the managers of the works he visits, can do a great deal for the firm which employs him. At the commencement of a contract he goes through the specification and drawings and clears up any doubtful points, both with his own firm and the contractors. He also informs the contractor what kind of work he expects to get and what processes are to be employed on the various details; for instance, it is often left to the inspector to say whether holes are to be drilled or punched; whether plates are to be sheared or planed, rods and bolts solid or welded, etc. When the work commences the inspector will test the materials and see that no unavoidable delay takes place at rolling mills, and will then follow the work through the contractor's shops and see that the various processes are carried out as specified, or as he wishes, and that the finished work comes together correctly, is of the proper dimensions, and, if necessary, is properly marked for re-erection. Besides these duties the inspector is often required to verify weights, and to attend to packing and shipping marks, and occasionally to see the goods actually put on board.

If he is a tactful man and knows his business, he can get the contractor's manager and foremen to agree to his suggestions and requirements with very little trouble, and to push his work on as quickly as possible, and in the case of any alteration he acts as a buffer between the buyers and the contractors. An inspector of this kind is worth a good salary, and if employers have not sufficient work to keep a highly-paid man of their own



Details of Door, C. M. & St. P. Cars.

busy, it is better for them to employ an outside independent inspector than to keep a poorly-paid man, or to send out draughtsmen or others on inspection work, as it takes a regular inspector several years to find out the little tricks by which foremen and workmen sometimes try to deceive him.

There are, however, a number of independent inspecting engineers who will offer to take inspection work at extremely low and insufficient rates. They can only do this by employing very young and badly-paid men to do their work for them, or else by giving half the time to it that they should. It may be taken as an axiom that in the majority of cases cheap inspection is worse than no inspection at all, as it relieves the contractor from liability without giving the buyer a sufficient guarantee that the work is properly carried out. There is, of course, certain work which can be attended to by an inexperienced inspector just as well as by an experienced one, but, as a general rule, when work which has been cheaply inspected turns out satisfactorily, it would have been just as satisfactory if it had not been inspected at all.

This brings us to the question of the abuse of inspection, about which manufacturers have a great deal to say, although it affects the buyers more than they are perhaps aware. An inspector may be very conscientious, but either through want of tact or experience, or both, he may be the cause of endless trouble between buyer and seller. Such a man walks into a works as though it belonged to him, calls the manager and foreman over the coals for the slightest cause, treats them openly as though he believes they are deliberately trying to cheat him, persists in sticking to the exact letter of the specification, and rejects quantities of material for little faults which do not matter in the least. The result of all this is that he is disliked wherever he goes, his work is delayed, and people who would not do it otherwise try to get the better of him in order to get him into trouble. Besides this, contractors who have had experience of an inspector of this kind makes allowance for him in their next quotation and ask higher prices.

Unnecessarily strict and minute inspection is not, however, always due to the inspector, as his employers may tie him down to the specification, and practically refuse to allow him to use his judgment at all. Certain consulting engineers are very strict in this way, and are so well known that extra prices are always charged to cover their inspection.

Another abuse of the inspection system is to send an inspector to see very small quantities of material; we have known many cases in which inspectors have traveled long distances to inspect, perhaps, 1 cwt. of ordinary quality steel, the cost of the inspection coming to two, three, or four times the cost of the material. Considerable delay is often caused, also, by having these small orders inspected, as the inspector may have to wait days before he can visit the works, owing to pressure of more important work, and favorable opportunities of forwarding the material along with other goods are thus missed. Moreover, if the material has to be tested, the inspector may have to pay two visits to the mills, one to select and stamp the test-pieces and another to see them broken, as the mills cannot always prepare the test-bars the same day.

To sum up the whole question: inspection is useful and worth while under certain conditions, but not under all conditions. It pays well to inspect, provided the inspector is a firm and tactful man with a good general knowledge of engineering and inspection, and with an honest and honorable character, and provided also that he has plenty of work on big orders and is given a fairly free hand and allowed to use his judgment in the interpretation of a specification. In other words, the inspector must be a good one and must have plenty to do, and the more costly the work that he inspects the more worth while the inspection.

Inspection, as a general rule, does not pay when the reverse of these conditions is the case: when the inspector is tactless, of weak character, without experience, or badly paid. It does not pay to be very strict on small variations from the drawing or specification which do not affect the quality of the work, nor to send an inspector to pass every small order, unless for special material. It is also a question whether it pays to inspect cheap materials, such as bricks, tiles, earthenware pipes, paving, etc. These things are bought in large quantities, and the inspector usually sees them stacked in the maker's yard. It is impossible for him to examine more than a small proportion unless he sees the whole order loaded up, which might oblige him to be at the works for several days, and would add considerably to the cost of the articles. He cannot very well mark each item unless he sees them loaded up, in which case there is no need to mark, and the result is he passes them in bulk, which leaves the manufacturer free to load up all the defective items not seen by the inspector. In the case of materials of this nature it is certainly the best way to buy on sample, without inspection, and return defective goods.

Whether a firm should employ their own inspector or not depends on whether or not they can keep him busy all the time. If they only require to have goods inspected occasionally, it is better to employ a regular outside inspector than to send out one of their own staff, unless he is fully qualified for the particular work. A firm has a better hold in some ways on its own inspector, but as the outside inspector's living also depends on the satisfactory nature of his work, he is not likely to neglect it, and a well-established outside man has a wider experience of inspection than a man who only works for one firm, and experience counts for a great deal in inspection. The more works a man visits, and the greater variety of materials he inspects, the quicker he will be to detect bad work, to suggest improvements, and to get orders through satisfactorily.—*Engineering.*

EXPERIMENTING WITH A DIESEL LOCOMOTIVE.

Some accounts have been published regarding the Diesel locomotive which has been constructed at Sulzer's works at Winterthur, Germany. This locomotive is the outcome of many years of collaboration between Dr. Diesel and the Swiss firm. The present intention is to run the locomotive on the Prussian Railways if its operation is found to be satisfactory, but too much importance must not be attached to this point, since a consideration of the difficulties to be overcome will at once make apparent the unlikelihood of the first engine constructed being entirely suitable for main line traffic without modifications.

Much attention has been devoted to the question of an improvement in economy by the employment of a turbo-electric system, on which principle a locomotive was constructed by the North British Locomotive Company. Proposals have also been made to use a similar method, but to provide a Diesel engine to drive the dynamo instead of a steam turbine. Probably something will be done in this direction shortly, since such an arrangement would obviate the difficulties encountered by a direct Diesel engine drive in the matter of starting, variation of speed, and overload capacity for steep gradients together with the question of reversing which is, however, not so serious as might be supposed.

The motor which Messrs. Sulzer have constructed is of the four cylinder type working on the single acting two-cycle principle and capable of developing normally about 1,000 b. h. p., though it is anticipated that this will be considerably exceeded. The engine drives a loose shaft to which the two driving wheels are coupled, the locomotive having two two-axle bogies. In order to produce a high starting torque and to develop greater power when ascending inclines an arrangement has been devised by which an auxiliary supply of fuel and air is provided for the cylinders and it is hoped that by this method some of the difficulties previously mentioned will be overcome. The weight of the locomotive on the rails in running order is between 80 and 90 tons, and the length over the buffers is about 55 ft.

OIL-BURNING LOCOMOTIVES.*

By R. Godfrey Aston, of Rincón Antonio, Oax., Mexico.

The object of this paper is to give an account of liquid-fuel burning in the locomotives of the Tehuantepec National Railway, showing some of its advantages over coal, and giving a general description of facilities for handling and storing this fuel-oil, the methods of burning it, and a few results gained, which are taken from the monthly performance of locomotives. The author does not intend to deal fully with costs, etc., as it is too large a subject for so short a paper, but will confine himself to a more practical point of view.

The Tehuantepec Railway is a trans-continental line, of standard gauge, 189 miles long, running across the Mexican Isthmus of Tehuantepec from the port of Puerto Mexico (Coatzacoalcos) on the Atlantic, to the port of Salina Cruz on the Pacific, with grades varying from level to 2.15 per cent, and abounding in curves up to 11 deg. 28 sec. radius, and where the speed of trains is limited to 15 miles per hour.

Storage Facilities.—All fuel-oil for the company is received at the terminal of Puerto, Mexico, where the main storage tanks are situated; these comprise three cylindrical steel tanks, each composed of six tiers of steel plates riveted together and a light steel roof, with three manholes, and a ventilator in the middle, through which gases arising from the oil can escape. Two of these tanks are 95 feet in diameter and 37 ft. 6 in. deep, each with a capacity of 46,996 barrels of 42 U. S. gallons. The third tank is 92 ft. in diameter and 29 ft. 9 in. deep, and has a capacity of 35,138 U. S. barrels.

These tanks are all enclosed in separate earthen embankments and are connected together by an 8 in. pipe-line, which enters the tanks 1 ft. 6 in. from the bottom, this space being required for water settling out of the oil, and which can be drawn off through a 3 in. valve at the bottom of the tank. The pipe-line runs down to the wharf, where it is fitted with an 8-in. check-valve, and it is from there that vessels delivering cargoes of oil can pump straight into any tank, the two largest tanks being about 1¼ miles from the wharf. At convenient places in the pipe-line near to the round-house are stand-columns for filling engine-tanks, tank-cars, etc., and near the round-house is also a supply-tank of 28,000 U. S. gallons capacity, erected upon a structural steel frame, also used for giving oil to engines.

The terminal of Salina Cruz is laid out in the same manner, except that there are only two storage-tanks, 95 ft. diameter and 37 ft. 6 in. deep, of 46,996 barrels capacity. The capacity of all these storage-tanks has been calculated out in U. S. barrels of 42 gallons for every 6 in. of depth, allowance being made for all internal stays and supports. The fuel oil is shipped from Puerto Mexico to the other fuel-stations in specially constructed double-truck steel-frame tank-cars of 6600 U. S. gallons capacity, the gallons per inch of depth of these cars being known, so that the exact amount contained in each car can be credited to the station to which it is shipped.

Fuel-Oil.—The fuel-oil used by this company is purchased from the Texas Company of Port Arthur, Texas, at about 97½ gold cents per barrel of 42 U. S. gallons, delivered at Puerto Mexico, and pumped into the railway company's tanks by the delivering vessel. This fuel-oil is generally delivered in tank steamers, sometimes towing barges, which come right up alongside the railway company's wharf; the coupling between the vessel and the company's land-pipe line is made with a flexible rubber or steel hose, which is supplied by the vessel.

This fuel-oil is quite thin and flows readily through pipes of any diameter; it is sometimes nearly black in color, and sometimes a dark brown with a green fluorescence. The railway company stipulates in its contracts with the Texas Company that the flash-point (closed) shall not be under 110 deg. Fahr., as a lower flash-point than this is liable to be dangerous, on account of the volatile gases and fumes which arise from the oil at comparatively low temperatures, and the author has seen the oil catch fire from a torch which was some 10 ft. or 12 ft. away from it. Some oils may be used in the crude state as fuel, while others have to be passed through the refinery; after the lighter oils have been taken off, the by-product or residuum is used in a satisfactory manner as fuel, and as such has been, and is, used in Mexico. Fuel-oil contains no power of spontaneous combustion, and, unlike coal, does not deteriorate if stored in tanks or reservoirs.

The specific gravity of this oil varies from 0.790 to about 0.942, and its weight per U. S. gallon from 6.4 lb. to 7.75 lb. The British thermal units vary from 17,000 to 20,000, the average being from 19,500 to 19,800, and between this and the best steam coal there is a very great difference. The analysis of two samples of the oil as used by this company for fuel is as follows:—

Specific gravity at 60 deg. Fahr.	0.931	0.881
Baume gravity at 60 deg. Fahr.	20.5 deg.	29 deg.
Flash-point (closed)	130 deg. F.	135 deg. F.
Flash-point (open)	160 deg. F.	160 deg. F.
Fire-test	220 deg. Fahr.	224 deg. Fahr.
Setting point	3 deg. Fahr.	20 deg. Fahr.
Viscosity at 100 deg. F	200 seconds (Redwood)	78 seconds (Redwood)
Sulphur	0.77 per cent.	0.26 per cent.
Calorific value	10,688 calories	11,000 calories
Color	Dark brown	Dark brown
Water and dirt	1 per cent.	0.25 per cent.

The standard temperature for the measurement of fuel-oil is 60 deg. Fahr., and expansion is allowed for at the rate of 1 per cent. for every 20 deg. Fahr. increase in temperature above 60 deg. Fahr., and contraction at the same rate for decrease in temperature below 60 deg. Fahr.

Locomotives.—The locomotives in use on this road are of the Baldwin consolidation type, the main dimensions of which are:—

Cylinders	20 in. by 26 in.
Wheels (drivers)	53 in. diameter on tread
Fire-box	Length inside, 108 in.; width inside, 33½ in.
Flues	239 of 2 in. outside diameter
Grate area	24.94 sq. ft.
Heating surface	Fire-box, 147 sq. ft.; flues, 1700 sq. ft. Total, 1847 sq. ft.
Boiler pressure	170 lb. per sq. in.

The oil-tank is fitted into the coal-space of the tender, and its contents canculated for every ½ in. of depth. Most oil-tanks have a capacity of 2,000 gallons, and the oil is fed from the tank to the burner or atomiser through suitable connections and flexible brass ball-joints.

Fire-Box Arrangement.—The company's practice, after trying various types of burners and atomisers, is to use what is called a "front-end burner" (Fig. 1 and 2); that it, the burner-mouth points toward the back of the fire-box or fire-box door-plate; the burner is placed, in a 9-ft. fire-box, 4 ft. 2 in. from the flue-sheet, the flame playing against a brick wall built up to the level of the fire-box door opening. Between this brick wall and the fire-box back-plate is a 4-in. air-space extending the whole width of the fire-box and right up to the top of the brick wall. Brick walls are built up on each side of the fire-box from the height of the brick wall at the back, gradually sloping downwards; the floor of the grate or ash-pan is laid all over with fire-brick. No brick arch or baffle-plate is used.

As mentioned in the preceding paragraph, the burner is placed 4 ft. 2 in. from the flue-sheet, and midway between the sides of the fire-box, so that both in front and behind the burner or atomiser there is a flat bricked-over area of fire-grate; and as the burner is placed parallel to the lower grate, there is a 4-in. space between the front and back grates, this 4-in. space being left open to admit air, extending from one side of the fire-box to the other.

Brickwork.—This should be of the very best material and workmanship, as it is subject to a much greater heat than from

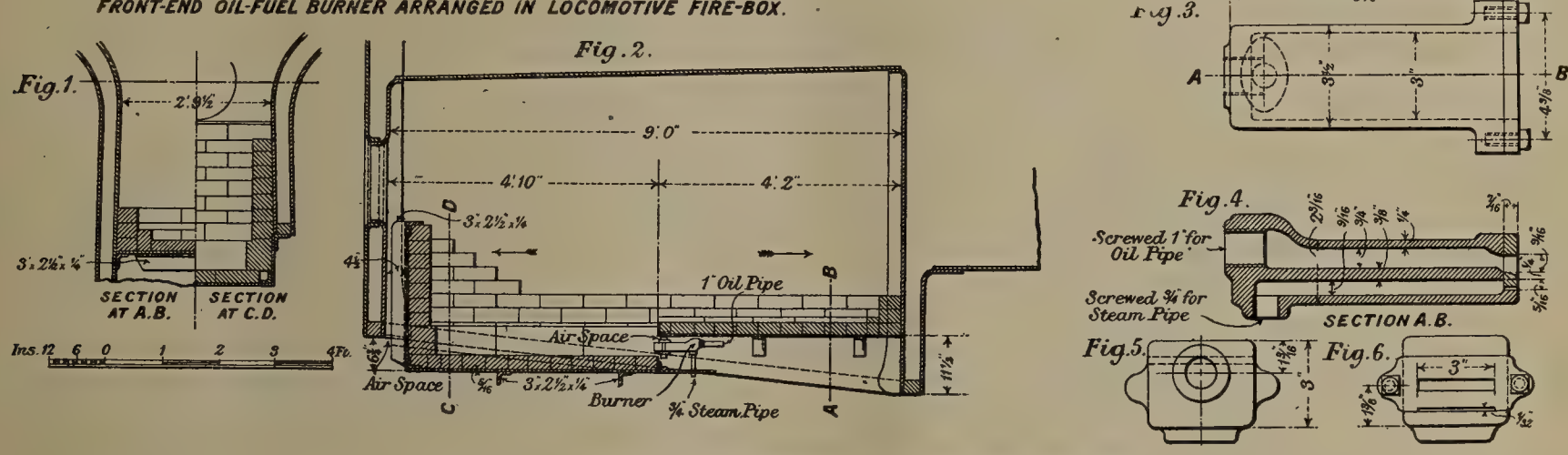
*Paper read before the Institution of Mechanical Engineers, December 15, 1911. Illustration reproduced from "Engineering" of London.

a coal fire; if this is not done, the walls will not stand, and engine failures will occur; moreover, the failure of only one brick will perhaps necessitate new brickwork throughout, thus needlessly running up expenses. There is no reason why the brickwork should not stand from four to six months, and perhaps longer, if due care be taken from the start.

A good brick should contain about 80 to 85 per cent. of silica and from 20 to 15 per cent. of alumina, and should be as free as possible from alkalies, which cause fluxing. A good brick becomes surface-glazed though remaining rough and porous; it should be perfectly dry when built up in a fire-box, otherwise the heat will cause it to crack; if possible, the fire-bricks should be fired at a temperature as high as that to which they will be exposed when in use.

Burner or Atomiser.—There are many and various kinds of hydro-carbon burners, and after a trial of various types, including the Baldwin and "Best" burners, this company is using with considerable success a burner which is made in their own shops, and which is really an inverted "Best" burner (Figs. 3 to 6). It is a simple device, which allows the oil to fall from an orifice 3 in. wide by $\frac{9}{16}$ in. deep over the top of a flat steam-jet 3 in. wide and $\frac{1}{32}$ in. deep, the steam picking up the oil and sending it into the fire-box in the form of a spray; the underneath jet of steam delivers the spray of oil at an angle so that it strikes the brick wall in the middle, instead of shooting out from the burner parallel with the bottom of the ash-pan. This burner may be called an outside atomiser, and although it is in general use, it has its drawbacks; but it has been found to be more efficient than any other they have used.

FRONT-END OIL-FUEL BURNER ARRANGED IN LOCOMOTIVE FIRE-BOX.



General Arrangement and Details of Oil Burning Firebox.

The most essential points about a burner or atomiser are:—

1. Its atomising capacity. All fuel-oil is heavy, and will burn in the form of a vapour spray only when mixed with air. The object should be to fill the fire-box with a soft and voluminous flame, and not to impinge it in any one place.
2. Its facility for keeping clean and free from clogging.
3. Its adjustability in giving the right direction to the flame or spray, and regulating the proper proportion of oil and the agent, either steam or air, used for atomising.

A burner which will vaporise or atomise the oil at the point of expansion of the agent used for that purpose, and which is easily handled, and which will atomise the greatest amount of fuel with the least possible energy, is the highest and most efficient that can be designed. On this railway steam is used as the atomising agent, because, after various experiments, it was found to be superior to air. The steam to a very great extent heats the oil as it flows into the burner before delivery in the form of a vapour spray. The flame from the burner should not be too long, or it will pass into the flues and become extinguished. Gases which are only partly consumed will re-light in the smoke-box.

Lighting up an Oil-Burning Engine.—In each roundhouse of this company is a stationary boiler, always in steam, used for the washout and other pumps, as well as for lighting up dead engines. From this boiler is laid a 2-in. steam-line to points between each engine road or stall. From there a connection can be made to a locomotive through a three-way cock T-piece in the steam-pipe leading from the steam-stand on top of the fire-box to the burner; by use of this steam the burner can be started and kept going until the boiler has generated enough steam to keep the burner going itself. A piece of oily waste is lighted and thrown into the fire-box just in front of the burner from which the spray ignites. Connections can be made to any other engine all ready in steam should the stationary boiler not be available for any reason.

Firing and Cleaning Flues on Road.—With an oil-burning engine there is always a fire of equal intensity and one which never gets dirty, so that good steaming is practically ensured. It is a popular idea that it is a very easy matter to fire an oil-burning engine, but this is not the case, as both skill and care are required, so that the author thinks it best to lay down a few of the most important rules:—

1. See that the oil-tank is full, and if heaters are used, that they are in operation, and that the temperature of the oil is as it should be.
2. See that the sand-box on the foot-plate is full, and that the scoop is in its place.
3. Before starting the fire see if the temperature of the fire-box is below igniting point, which is a dull red, and if so, open dampers (if used), start the blower, and open the atomiser-valve fairly hard; then put a piece of saturated oily waste on the bottom of the grate after setting it alight, close the dampers (if used) and fire-box door, and turn on the oil very light. When the oil has ignited, reduce the blower and atomiser to a light feed, also the oil until the chimney is quite clear of smoke.
4. See that the fire is burning brightly, and that there is no oil on the bottom of the pan, also that the brickwork is in good condition, and that no bricks or any other obstructions are on the bottom of the grate or pan so as to obstruct the flame or jet on its way from the burner to the brick wall.
5. As regards cleaning flues on road, it is best to sand frequently if the engine is being worked hard—say every 9 or 12½ miles; but if the engine is being worked light, every 31 or 37 miles will be sufficient.
6. Having attained a fair rate of speed, fill the scoop with about a quart of sand, close dampers (if used), and put reverse-lever near full stroke, then open regulator wide, insert the end of the scoop in the round hole in the fire-box door, and allow the sand to be drawn out of the scoop through the fire-box and flues and out of the chimney; sanding is best done when the engine is working hard up a grade.
7. Black smoke shows incomplete combustion, and should never be allowed to be emitted from the chimney, as it only fills up the flues with carbon, besides being a non-conductor

of heat, and it is also a great waste of fuel. If a bluish-coloured smoke or fumes are seen coming from the chimney, it is a sign that the burner is cut down too fine.

8. When putting out the fire the oil-valve should always be closed first, then the atomiser-valve (in their case steam), then the blower. The oil-valve is always the last to be turned on and the first to be turned off.

9. Never go near an open tank with a lighted lamp or torch, as at any time an explosion may occur, especially if the oil used has a low flash-point.

Round-House or Shed Work.—An oil-burning engine has a great many advantages over a coal-burner, but this is specially noticed in the round-house or shed when squaring up an engine after a day's run; there are no fires to be raked out, no flues or smoke-box to be cleaned (the smoke-box door of an oil-burning engine need be opened only once every three or four months for cleaning purposes); there is no coal to be sacked, weighed, or otherwise handled, and oil-burning engines do not carry fire-rakes, prickers, flue-brushes, shovels, or picks, so that all these things, besides other minor details, represent a great saving in engine equipment.

Among other advantages are the rapidity with which steam can be raised, and the facility with which the boiler can be forced when greater calls are made; the author has in a special case of necessity raised steam in a dead engine to a pressure of 130 lb. per sq. in. in 50 minutes from cold water, without any serious effects on the boiler, whereas in a coal-burner from 2 to 3½ hours is needed to raise steam if no jet from a live engine is used.

Another very great advantage is in switching, or shunting, or standing pilot, when engines frequently have to stand in steam for hours at a time. The burner can then be cut down or extinguished, thus effecting a great saving in fuel, as an engine will always retain a sufficient amount of steam to start the burner or atomiser again; and any danger of the fire-box or crown-sheet being injured through the water getting too low is entirely obviated. The heat lost while standing is the same whether coal-fired or oil-fired.

Effects of Oil-Burning on Fire-Box, Flues, Etc.—Oil-burning is no more injurious to a fire-box or flues, etc., if ordinary care be used, than coal-burning; in fact, from the author's experience, it is not so hard on a fire-box as coal-burning, for it is quite noticeable in the fire-boxes of coal-burning engines that stay-heads, plate-edges, flue-ends, and crown bolt-heads show signs of wear, corrosion, or burning, but in their oldest oil-burning engine not any of these signs are noticeable, everything being clean and in good condition.

This company uses steel boxes with wrought-iron tubes and copper ferrules. A set of tubes will last, and remain perfectly tight, from 2½ to 3½ years, when they may have to be taken out to be re-ended; some of the engines are working to-day with tubes over four years old, many of which are as tight as they were on the day they were put in. Some of the wrought-iron tubes are being replaced by mild steel, because, after the holes in the tube-sheet get worn, tubes of steel stand the expanding better; but at present those that are in service have not been in use long enough for one to form an opinion of them as compared with wrought iron.

Some people are of the opinion that more than 2 per cent. of sulphur in fuel-oil is injurious to the fire-box, but as the amount of sulphur in the Texas oil the company has been using is below 0.75 per cent., no ill-effects have been noticed; but as there are coals which show as high as 3.5 per cent. of sulphur, the author does not see why sulphur should be more injurious in oil than in coal.

Engine Performance.—Although the engine tonnage has practically doubled since 1908, the author gives the following statistics, for each month from January, 1907, to August, 1911:—

(1) Cost of fuel-oil per barrel of 42 gallons (Mexican currency);

(2) Cost per mile for fuel (Mexican currency);

(3) Miles run per barrel of oil;

It must be understood that since about the middle of 1909 all engines are loaded down to their capacity, single trains averaging 750 to 800 tons behind the draw-bar. As the road-bed is by no means level, helper engines are used over certain sections where the grades are long and heavy, so that this will explain the decrease in miles run per barrel of oil between 1908, 1909, 1910, 1911, as the tonnage per engine has been increased to the maximum.

Oil Fuel—Monthly Averages.

During	Cost of Oil per Barrel in Dollars (Mexican).	Cost for Fuel in Cents (Mexican) per Mile.	Distance Run per Barrel in Miles.
1907	2.585	45.8	5.928
1908	2.957	43.7	6.855
1909	2.502	40.6	6.209
1910	2.356	40.3	5.843
1911 (8 months)	1.990	35.8	5.520

(Note—The value of the Mexican dollar is about 49 cents.)

The cost of fuel-oil per barrel of 42 U. S. gallons (231 cub. in.) as charged out every month is made up of the following items, and also depends upon whether there is any shortage or overage when the inventory is taken at midnight on the last day of each month; this accounts for the variation in prices:

1. Price of oil per barrel f. o. b. in ships' tanks at delivering port (Puerto Mexico).
2. Commission to purchasing agents in United States.
3. Consular invoices.
4. Inspection fees for inspecting cargo in ships' tanks at shipping port.
5. Stamps.

Items 2, 3, and 4 only refer to oil purchased out of Mexico.

Based on tests which have been made, the company reckons 3½ barrels, or 147 U. S. gallons, of oil as being equal to 1 ton of coal or 1,000 kg., or 2,204 lb. or 3½ barrels of oil equal to one unit of fuel.

The author is unable at this time to give any reliable data of fuel consumption on a tonnage basis, as no records are kept of the company's freight hauled over the road, although it is considerable; but the average loaded passenger and freight cars hauled 1 mile per unit of fuel from January 1 to December 31, 1910, was 210.7, and from January 1 to June 30, 1911, 208.8. The average loading weight of freight-cars is approximately 30 tons.

In August this year (1911) the company received the first cargo of a native or Mexican fuel-oil, under a contract with the Campania Mexicana de Petroleo, El Aguila, S. A., at a price of 1.75 dols. (Mexican) per barrel of 42 U. S. gallons delivered into railway company's tanks at Peurto Mexico. This oil, which is used in its crude state as fuel, is jet black in color, thick, and has a very heavy asphalt base, and although the company has not used it sufficiently long to be able to compare it with the Texas oil, it may be of interest to state a few of the difficulties met with when first they began to use it.

As this oil is thicker than Texas oil, heaters have to be used in the engine-tanks, but it has been found that if this oil is heated up to about 150 deg. Fahr. (which can be done with Texas oil), great difficulty is experienced in getting the burner spray to light, and the oil settled very thickly at the bottom of the tank; it would not run through the pipes to the burner, and could only be burnt effectively by mixing a fresh supply of oil with it. In order to burn this Mexican native oil successfully, it requires to be only just warmed. When using this, a large piece of carbon or coke-like substance is formed in the fire-box, and grows up from the bot-

tom of the pan or grate directly under the burner-mouth. This may vary from 6 in. by 4 in. by 4 in. to 12 in. by 10 in. by 8 in. in size, growing up in such a manner as almost to smother the burner-mouth. The analysis of this substance is as follows:

	Per cent.
Ash	1.25
Sulphur	7.89
Carbon	90.86
Asphalt	nil

It shows, to a certain extent, that there is incomplete combustion, which can be remedied by admitting more air; but this cannot very well be done without affecting the steaming qualities of the engines. However, by raising the burner slightly, these lumps of carbon have decreased in size, and it is hoped eventually to adjust things in such a manner as to prevent their forming at all.

The analysis of two cargoes of this Mexican crude fuel-oil is as follows:

	No. 1.	No. 2.
Specific gravity at 60 deg. Fahr.	0.944	0.942
Baume gravity at 60 deg. Fahr.	18.4 deg.	18.8 deg.
Flash-point (closed)	78 deg. Fahr.	102 deg. Fahr.
Flash-point (open)	104 deg. Fahr.	120 deg. Fahr.
Fire test	165 deg. Fahr.	180 deg. Fahr.
Viscosity at 100 deg. Fahr.	1080 seconds (Redwood)	920 seconds (Redwood)
Sulphur	3.44 per cent	3.35 per cent
Calorific value	10,971 calories	10,610 calories
Color	Black	Black
Water	Nil	0.5 per cent
Asphalt	.....	37 per cent
Carbon (coke)	.....	12 per cent

It may be explained that the 37 per cent asphalt is obtained by distilling off the distillates from the crude until only 37 per cent residue is left, which consists of asphalt. The 12 per cent coke is obtained by distilling this 37 per cent down to 12 per cent residue (on the crude); so that if they get 37 per cent asphalt, they do not get the 12 per cent coke; and if they get the 12 per cent coke, they do not get the 37 per cent asphalt.

The author regrets that at this time he is unable to go deeper into this subject, but he hopes that what little information he has been able to give with regard to oil-fuel burning in the Tehuantepec locomotives will be of interest to others working in the same direction.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.

The American Railway Tool Foremen's Association is now in its third year and is at a stage where it needs active co-operation and support. Those eligible for membership are foremen in charge of tool rooms in steam and electric railway shops.

Following is the list of topics and committees of the American Railway Tool Foremen's Association for the 1912 convention:

1. Standardization of Steel for Small Tools—Henry Otto, chairman; W. J. A. M. Roberts, C. A. Cook, J. Martin and A. Sterner.

2. Milling Cutters, Their Formation, Tempering, Etc.—A. R. Davis, chairman; Gust Gstoettner, W. A. Fairbairn, J. A. Shaw, F. W. Lugger and A. W. Meitz.

3. Care of Shop Tools—J. W. Pike, chairman; H. I. Derby, O. H. Dallman, Thos. Grant, E. R. Purchase and G. L. Linck.

4. Checking Systems—J. T. Fuhrman, chairman; J. B. Hasty, Wm. Greilich, H. E. Blackburn, Gilbert Mitchell and F. Peterson.

5. Treating Steel in Electric Furnaces—G. W. Jack, chairman; B. Hendrickson, J. C. Breckenfeld and C. A. Shaffer.

The next convention is to be held in Chicago the second Tuesday of July, 1912.

RAILWAY SHOPS IN PITTSBURGH.

The value of the product in the annual output of the car and the general construction and repair shops of the steam railroads in the metropolitan district of Pittsburgh was $16,804,878, according to the industrial census just compiled by E. Dana Durand of the United States Census Bureau and announced by the Pittsburgh Industrial Development Commission. This is the first census that has been taken of the manufacturing district within a radius of 15 miles of the center of the city. The metropolitan area includes many populous communities outside of the municipal boundaries of Pittsburgh. The capital invested in the car and general construction and car repair shops for 1909, the latest year for which statistics are available in the federal census bureau, was $8,684,822, while the number of salaried employes and wage earners was 10,374 with an annual payroll of $7,384,813. The cost of material was $9,164,034 and the value of products $16,804,878.

AMERICAN ASSOCIATION OF RAILWAY SUPERINTENDENTS.

It is understood that at a meeting called by the American Association of Railroad Superintendents, and held in St. Louis on March 1st, to consider the matter, the representatives from the various sections throughout the country were strongly in favor of commencing the carding practice at the earliest possible date. A goodly number of cities have already arranged to apply M. C. B. defect cards covering all cardable defects, effective April 1, 1912, and any delay beyond that date at any interchange point will, so it is understood, be due to the fact that the mechanical representatives of the railroads entering such points have not sufficiently drilled interchange inspectors in the M. C. B. rules. Whatever of opposition to the carding plan that may have existed in times past on the part of transportation officers appears to have been entirely eliminated, and the American Association of Railroad Superintendents has offered to do whatever it can to enable the mechanical departments to make the M. C. B. rules operative at all points of interchange throughout the country.

RELATION OF RAILWAYS TO HIGH COST OF LIVING.*

By Roy F. Britton.

The railways and the high cost of living are both timely and interesting subjects for thought and discussion. In one sense they are related for all who are familiar with the situation know that the railways' cost of living has considerably increased during the past few years. Recently a large number of reliable statistics and other information relating to American railroads have been compiled and issued by the express authority and sanction of the companies, and this has served to give publicity to many conditions which had previously been misrepresented by designing political demagogues, some self-serving so-called "traffic experts" of shippers' associations, irresponsible magazine writers and others who sought to popularize themselves by joining in the clamor against the railroads. Fortunately we appear to be approaching the dawn of a new era of the "railroad problem." There seems to be a growing realization on the part of the people that their interests are more closely identified with the prosperity of the carriers than they had supposed. Not only are over 6,000,000 persons directly dependent on the railroads; but the welfare and security of many more millions are indirectly dependent upon them. For instance, in 1910, thirty-five life insurance companies with over twenty-eight million policy holders owned over one billion dollars

*From a paper read before the St. Louis Railway Club.

worth of railroad bonds—about one-ninth of the total funded debt of the railroads—and this represented nearly 40 per cent of the current assets of those insurance companies; the savings banks in six eastern states, with over six million depositors, partly secure their deposits with over six hundred million dollars worth of railroad securities, which represent 22 per cent of the deposits. The public may, therefore, well look into the facts, and it is gratifying that an earnest effort is now being made to disseminate the truth. You gentlemen being interested in railroading in one way or another, no doubt, are familiar with these statistics and, therefore, much that I shall say will seem platitudinous and much a repetition of time-worn matter, but it is interesting to focus these facts and figures of railroad conditions to the question of the high cost of living and closely scrutinize the result to determine whether or not the railroads have in any way influenced this cost.

My discussion is, for the most part, confined to the past ten years, and at the outset we should determine to what extent the prices of commodities which, generally speaking, make up the necessities of life, have increased during that time. This is fully analyzed in the reports of the United States Bureau of Labor. The average prices from 1890 to 1899, inclusive, are used as a basis for the computations, and it is shown that the retail prices of thirty articles of food in 1910 had increased from 3 per cent on rice to 80 per cent on salt pork and bacon, the prices of other commodities ranging between these two extremes. The average increase in wholesale prices of food was 33.8 per cent, on cloths and clothing 26.9 per cent, fuel and lighting 30.3 per cent, and building material 53 per cent.

Commerce enters into every phase of our existence; transportation is one of the most important factors of our daily life. Substantially everything we eat, everything we wear and everything we use in our households and in our business has at some time or in some form been an article of commerce. The railroads are by far the most important means of transportation; they carry the raw material to the factories and the manufactured product to the retailer; they carry seed, fertilizers, agricultural implements to the farmers, and the products of the soil to the market. They are the great distributing agencies of the surplus products of the land and of the output of our industries. They have made possible trade, as we understand it in these modern times. Transportation contributes all of the increased value given to the commodity by its carriage to market. Transportation is performed often many times on the manufactured article and the product of agriculture.

As an abstract proposition, therefore, it would seem that freight rates must have a direct influence on the cost to the consumer of all articles of commerce. But a careful analysis will develop the fact that in the cost of producing manufactured articles or in the selling price of any article of common consumption the transportation charge is really a negligible factor, except in a few rare instances where the source of supply is an unusual distance from the place of consumption. If we could eliminate from consideration commercial conditions, the forces of competition—both of carriers and of markets—and government regulation, it might be fairly said that freight rates could have a direct controlling effect on market prices. But these elements never are or never can be lost sight of when rates are made.

Before the days of government regulation it was complained that the railroads charged "all the traffic would bear." When the state and federal governments set about to make rates for the railroads this principle was at first openly repudiated. A futile attempt was made to substitute mileage rates and to apply that unascertainable quality—"cost of service." The mileage scale is unsatisfactory, especially when applied to long hauls, because it builds up small trading territories and circumscribes the operations of large distributing centers. It is obviously impossible to differentiate the cost of hauling a carload of sand from the cost of hauling a carload of merchandise the same distance. It is well known by all familiar with railroad rates that the cost of service, even if it could be determined on particular movement, can have little to do with making a rate on a partcular commodity. The value of the commodity, commercial conditions at the point of production and the point of consumption, relative markets and many other industrial conditions are frequently necessary controlling factors, while distance in fairness to the shippers themselves must be considered as a minor factor. In making a classification one of the first considerations is the value of the article to be carried. The rate is based upon the value as reflected by the prevailing selling price, rather than the price being predicated on the rate. So the old principle has come back under a new and dignified name, "Value of the service," and is now generally recognized and applied especially by the Interstate Commerce Commission and the Federal courts. In passing it might be of interest to note that as the wholesale price of nearly every article of commerce has increased over 30 per cent in the past ten years, the power of each article to purchase transportation service has relatively increased, but the railroads have been denied the right to advance their rates on this account.

The fair and equitable application of freight rates is well illustrated by the fact that many articles of general use are sold at the same price all over the country. For instance, oranges, which are produced exclusively in remote parts of the continent, are sold at substantially the same price everywhere, even though the transportation service varies to different markets. The same brand of shoes, cigars, soap, proprietary medicines and many other articles of common daily use are sold at the same retail price all over the United States. The principal biscuit company sells its product at a delivered price, the company absorbing the freight charges. One of the largest manufacturers of fertilizers sells its products to the farmers all over the Southwest at the same delivered price, although the ingredients are obtained from widely varying sources of supply. If transportation charges had any appreciable effect on determining the selling price, we would never see or hear of such common advertisements as "Jones pays the freight."

When we reduce transportation charges to the rate per article, the absurdity of the proposition that the rates affect the retail price is apparent; for instance, a 50-pound sack of flour from the mill to the consumer pays a freight rate not exceeding eight or nine cents, and products of the beef, or the hog, are carried from the western packing houses throughout this territory at rates from one-fifth of to not exceeding one cent per pound. A 700-pound beef carcass, which, if retailed at an average of fifteen cents per pound, would bring $105, has paid the railroads between $3.50 to $4 for transportation from the far West to New York. The transportation charge on the material entering into a pair of shoes made in a St. Louis factory averages one and one-fourth cents, and the charge required to place that pair of shoes in the hands of a consumer in any part of the United States averages from two to three cents. The material entering into an ordinary bedstead such as retails in St. Louis for $8 will have paid the railroads about forty cents. An ax made in the Pittsburgh district, that retails in St. Louis for $4, will have paid the railroads one and one-fourth cents. A padlock which retails at fifty cents here pays freight charges amounting to little more than one-half a cent; at Denver it will have paid two cents, and out there that padlock retails at seventy-five cents. A stove that weighs 200 pounds and retails in St. Louis at $18 will pay forty-four cents to Kansas City or Omaha, and retail there

for $24. On a man's suit of clothes the freight charges amount to from two to eight cents, on calicos and ginghams, from one-fiftieth to one fifth of a cent a yard. The freight charges paid on the entire apparel of a man or woman in this section of the country ranges from six to eighteen cents. On woolen goods from any of the New England mills, cloth which will sell from $1.50 upwards in any of the western markets pays the railroad not more than five cents from the sheep's back in Colorado to Massachusetts and back again to the Mississippi River. These are examples of the relation between freight rates and retail prices.

The figures are taken from Mr. McPherson's work on Railroad Freight Rates and are based on the tariffs in effect in 1907, and it may be said that the increases in rates since that time have been a factor in the recent advance in retail prices. The average general increase is usually not more than 10 per cent, but suppose it were 50 per cent, or, if the modern human mind is capable of such a wild flight of fancy, suppose the railroads were permitted to increase their existing rates 100 per cent over those of 1907, the retail price of the commodities which I have just enumerated would not necessarily be changed thereby.

In his report for the year 1910, James Wilson, Secretary of Agriculture, gives the results of an investigation made by his department into the proportion received by the farmer of the price paid by the consumer for various agricultural products. He found that the farmer was not responsible for the advanced prices. On the transportation feature of the situation he says: "With approximate accuracy it has been determined that when the farmer receives 50 per cent of the consumer's price, the freight charge on butter is about 0.5 of 1 per cent of the consumer's price; eggs, 0.6 to 1 per cent; apples, 6.8 per cent; beans, 2.4 per cent; potatoes, 7.4 per cent; grain of all sorts, 3.8 per cent; hay, 7.9 per cent; cattle and hogs, 1.2 per cent; live poultry, 2.2 per cent; wool, 0.3 of 1 per cent. The railroad, generally speaking, adds a percentage of increase to the farmer's prices that is not large." From this it will be seen that the transportation charges represent such a small proportion of the consumer's cost that the rates would have to be enormously increased to exercise a controlling influence on this cost. The Secretary of Agriculture, in his report, exonerates the farmers and the railroads of responsibility for the high cost of living in these words:

"After consideration of the elements of the matter, it is plain that the farmer is not getting an exorbitant price for his products, and that the cost of distribution from the time of delivery at destination by the railroad to delivery to the consumer is the feature of the problem of high prices which must present itself to the consumer for treatment."

While I believe that rates have no effect on the cost of living, I do not contend that the railroads themselves are without influence in that respect. The American railways today have in their employ 1,754,400 men, whose total compensation in 1910 was $1,172,181,000. This represents an increase of 683,231 men, or 63.78 per cent, and $562,152,408, or 92.15 per cent, in the last decade. The large comparative increase in compensation over the increase in number of men is significant. The item of labor has been gradually consuming a larger portion of the earnings, for in 1901, the ratio of compensation of labor to operating expenses was 59.27 per cent, and 63.41 per cent in 1910, or an increase of 4.14 per cent. The ratio of operating expenses to gross earnings during this period advanced less than 2 per cent. It would seem, therefore, that the railroads' labor bill is largely responsible for the increasing cost of operation, but the cost to the companies is not what we are concerned with in this discussion.

Turning to a study of the amounts paid to those classes which make up the larger proportion of railroad employes, we find that the average daily compensation increased during the last decade as follows:

	1901	1910	Per cent
Station agents	$1.77	$2.13	20.34
Enginemen	3.78	4.59	21.42
Firemen	2.16	2.74	26.86
Conductors	3.17	3.93	23.97
Other trainmen	2.00	2.72	36.00
Machinists	2.32	3.07	32.33
Carpenters	2.06	2.51	21.84
Other shopmen	1.75	2.18	24.57
Section foremen	1.71	1.99	16.37
Other trackmen	1.23	1.47	19.51
Telegraph operators and dispatchers	1.98	2.33	17.68
All other employes and laborers	1.69	2.01	18.93

It should be remembered also that during this period the hours of labor for some classes were shortened. From these figures it appears that a considerable proportion of the increase of over $500,000,000 in the railroads' expenditures for labor was taken up by additional pay to the individual per day. Most of the advances in the rates of pay obtained by organized labor were sought largely because of increases in the cost of living, and the railroads constitute probably the only industry that has been compelled to meet every advance in the cost of living without meeting additional expenditure by increases in the price of the only thing they have to sell—transportation. The increase in the average daily compensation has probably exceeded the average increase in the cost of living during the last decade so that 1,754,400 men have had their ability to buy enhanced beyond the advance in the price of many staple articles of subsistence. But the railroads' influence in this respect is not confined to their own employes; the cost of materials, supplies and equipment has materially advanced during this period. The expenditures for rails, ties, equipment and hundreds of articles constantly used in the operation of railroads is enormous. I have no figures on the subject, but it is safe to assume that those who are supplying these needs have also been obliged to pay more for their labor now than they did ten years ago. The number of people who are thus indirectly dependent on the railroads and the extent to which they have been benefited by the increased selling prices of the articles which they are producing and which the railroads are buying is almost impossible to estimate.

But confining ourselves to railroad employes only, and assuming that the average family consists of four members, we find that at least 7,000,000 people, or over 8 per cent of the entire population of the United States, are directly dependent on the railroads for their livelihood. And to the extent that the railroads have prospered the individual, they have undoubtedly been a potent influence on the so-called high cost of living.

RAILWAY OPERATING ORGANIZATION.

(Continued from page 81, February issue)

We provide exceptions to this. If a man wishes to make his communication personal to a superintendent or assistant superintendent he can use the name and make it personal. A cat may look at a king. We don't take away the right of that man, but we prescribe a method. If a conductor should have a train order that he feels is an unsafe order he will go to the superintendent's office and ask if the superintendent wants him to run on that order. Perhaps the simplest and best methods that we have in railway operations are those of train dispatching, and we have tried to adapt those, carry them a little higher up to the administra-

tion of our office, to have simple, clean-cut methods in place of the more roundabout methods which have sprung up with the rapid growth of the railways.

Again, an objection to one man signing another man's name is this. When the superintendent goes out on the road his chief clerk begins signing his name to communications to men of lower rank than the superintendent, like the train master, the master mechanic, the division engineer, men getting larger salaries than this chief clerk and presumably of wider experience. Sooner or later those communications that go out take on the nature of instructions or restrictions. They begin with polite inquiries for information, but before they get through they enunciate policy or give directions. In other words, we have obstructed the flow of our stream. Something that should be passing from the $300 superintendent perhaps has to go through the $125 or $150 chief clerk to reach the $175 or $200 division officer, all of which must cost the company a little money in the unnecessary friction of getting through the smaller channel.

Right there we strike the most amiable feeling of human nature of all. Every man flatters himself, "My chief clerk doesn't do that." Well, we say to him: "That is very nice indeed, it is very fortunate to find that condition, but would you mind telling me about your boss' chief clerk?" The usual answer is, "Well, really my dear sir, you would not get me into any trouble by quoting me and I know you won't embarrass me, but it is strange the old man does let his chief clerk handle some things that are very embarrassing to me." "Well, why don't you go to the old man and tell him about this?" "Why, simply because he would tell me that I had better run my own office and he would look after his, that he felt himself qualified to look after his own chief clerk." It is too bad about the old man, but you see my own case is a little bit different. You know I used to work with my chief clerk's father, and he knows me just like a book. Oh, he never gets over the line. He knows I would not stand for it. Jacked him up two or three times about that." Gentlemen, I have taken the pains to observe and have found that when this man who complained of his boss' chief clerk was promoted to his boss' position the same thing went on. He might correct a particular phase that had caused him personal annoyance, but the system is there, showing conclusively to my mind that it is not the fault of any individual or set of individuals but is due to the failures of a system, because it is not honest to begin with. It pays to be honest.

Worst of all, gentlemen, is the effect upon the chief clerk himself. The chief clerk is out of line. He is becoming a piece of a man to act for somebody else, and the more valuable he is the more good men run round him. He stays there year after year till by and by he is too old to promote, and he breaks in all the new bosses. I ask you if that is fair and equitable. Can we get maximum efficiency when we so disregard the right of such faithful individuals? And faithful they are! So we substitute for the chief clerk the chief of staff. In announcing our new list of assistant superintendents we announce the man who was the assistant before as No. 1 on the list, and he takes charge of the office. It is the chief of staff instead of the chief clerk. The chief clerk, if it is a large division or a large office, remains as chief clerk, presiding over the other clerks, directing their work as a general foreman in a factory, if you please, in charge of all the employees engaged in that activity. Wherever we can, and as soon as we can, we try to take care of the chief clerk in an official position. We make him an assistant superintendent as soon as we can.

It is one of the crudities of the application which I have mentioned that it is very much easier to put that man in the office and not break in an outside man, and we find a tendency to do that which has been criticised, and very justly so, by a number of visiting railroad men, that that man is in the office, but where we get the best results is where the system is applied consistently. We have one division in Texas that suddenly jumped up in its record of fuel efficiency from low on the list to the head of our whole system. The old chief clerk had been put outside as a transportation assistant. The old train master, or he was assistant superintendent of the division, had been put in charge of the office. The old chief clerk was not only forceful but tactful, and remember, gentlemen, diplomacy is consideration for one's self, tact is consideration for the other fellow. He was so tactful that he got the engineers and firemen to handle their engines better, and the old engineers on the division said that they were astonished that that young man could come out of the office and show them something about running an engine. There was a consistent application of the new system. We have another division where the old chief clerk is an assistant superintendent acting as division storekeeper, and as his principal work lay at the big store, which was the most important engine terminal on our division, during our recent strike of shop men he not only looked after that store, but he took charge of all the activitives of the company at that point.

As said in the President's quotation from the able article of Mr. Arthur Hale, the test of a system is in an emergency. Perhaps the recent strike has done more than anything else to cinch the new system upon the Harriman Lines, because when the strike came an assistant superintendent was sent to each important point, and he had full authority to act. We had old division road masters and old division engineers organizing gangs of car repairers. I grant you that you can say, "Well, our division engineers will do it, too," and "our division road master." They do on some roads in some emergencies, but we claim there is less lost motion, that he does not have to go there and apologize for taking action, when that little loss of time may be costing the company money. He stops here and does the best he knows how until we can get a man there who is more skilled in the technique of that particular work; but, meantime, are not the company's interests better protected? We have found that they are.

So that we are trying to build up and help the chief clerk, not to down him as chief clerk, but we do want to down the chief clerk system.

A great many people ask why we address the assistant superintendent rather than the superintendent, that is, from the subordinate. The conductor or the engineer or the foreman out on the road addresses assistant superintendent. The answer is that if he addresses it superintendent there would be an implied obligation on the part of the superintendent to answer. We deny the right of a subordinate normally to dictate who shall handle his communication. The lower the man in the scale the less familiar he is with such things. If he had addressed a letter to the superintendent and got it back signed by some assistant superintendent he would feel that perhaps he had been slighted. There is no thought of slighting him, but when his answer comes back it will be signed by an assistant superintendent or the superintendent himself. Let us follow that through.

A letter come in from a conductor addressed assistant superintendent. Under the system it goes to the desk of the senior assistant, the chief of staff if you please, the man in charge of the office. He allots it to the particular man who handles those activities, the old train master if that man is in town, but he may say, "That is pretty important. There may be an appeal. We had better have the old man act on it." Or he may call in the train master and talk it

over with him, or he may, if the latter is out of town, act himself, or he may prepare a letter for the superintendent to sign. He takes that in to the superintendent, and the superintendent signs his own name to it or perhaps dictates his own letter, and the conductor is answered. Mind you, that does not have to go for record through this particular office, because the division is a unit. If the superintendent acts it makes it that much stronger; but he is too busy a man to be acting all the time. His signature now stands out, because instead of being signed by eight or ten people round the office they know it comes from the old man himself. Suppose that in the letter he asks the conductor for further information. The conductor comes back and addresses the reply assistant superintendent. For all he knows the superintendent has gone off on a vacation and left instruction as to how it shall be handled. We try, there, to be honest.

Coming from superior authority or co-ordinate authority, as for example the superintendent of the next division, communications are addressed superintendent impersonally, because there is an implied obligation for the superintendent to act. It is his duty, if he is there, to reply to superior authority. If he is not there we permit the chief of staff to act, and sign, "assistant superintendent, for and in the absence of the superintendent." That "for and in the absence of" is in the nature of an apology. He apologizes for his seeming assumption of authority, and apologizes for the apparent neglect of his superior to act. The superior is absent. It is largely a question of good manners now. Under the old order of things if superior authority had gotten a letter signed by this senior assistant superintendent they would say, "Why, here, that is a pretty presumptuous man over there. He seems to have discharged the superintendent and thinks he is superintendent." Now, gentlemen, we say that is too ridiculous to discuss. When a man has reached a grade as high as that we can trust him to have sufficient good taste, and we have not had our confidence violated in the good taste of our officers.

The correspondence is reduced usually by about 30 per cent, sometimes 50 per cent, in the division superintendent's office by these simpler methods, which of itself is worth something. It is not the paper that we are after, it is not the expense of another stenographer grinding out letters that we are after, but we are trying to get rid of this unnescessary correspondence because it clogs the wheels and because it does more harm than good, and worst of all, because it dwarfs initiative by trying too often to think for the man below.

Concrete cases always appeal more than the abstract. I preach the doctrine that the specialist is needed in the stage of installation and construction, but that for every day operation and maintenance the specialist should do his work so well that the layman can carry it through. When we got ready for the re-organization of one of the first divisions some three years ago, with the master mechanic moved, after having a committee on floor space to allot the space, with clerks pooled, and the filing room arranged, they were ready to start on a certain day. Some one happened to remark to me, "You will be here two or three weeks helping us, I suppose." I said, "No, indeed, if this depends upon me you don't want it. The specialist is needed only in the stage of construction and installation. I am a specialist in organization, and I am going away to-morrow night." I confess that I would have been very glad to stay, but I felt that if I did stay by just so much I would belittle the superintendent. Everybody would have been running to me for decisions. I would have been purely a question of taste as to whether the superintendent wanted it one way and I another, but that superintendent had to carry the load all the time, and he carried it mighty well.

In about a month I came back to see how they were getting along. They were meeting at that time every Monday morning. Men are prone to mistake coincidences for causes. A great many people thought that was part of the system. The system has nothing to say about that. They could meet every day or every week or every month; but the superintendent was very wisely having them meet at that time once a week. I think they now meet once a month. I made it convenient to attend a Monday morning meeting. The superintendent called upon various gentlemen for their experiences of the past week. The old division engineer said: "I have had occasion to ride the way freights this week in the performance of my maintenance duties, and have found that our conductors delay teams in these country villages; while they are switching they block these crossings, which I have required them to open. Being an assistant superintendent, they obey my instructions. It so happened that at that very time there was a bill before the state legislature increasing the penalities for holding country crossings. If we got out and attended to these things ourselves, gentlemen, we would sometimes head off some of the legislation—not all of it, but some of it.

Then it got down to the old master mechanic. He said, "I have got a kick coming. Here I was out five days on the road last week, and I got in here Saturday morning and there were a few papers on my desk about technical matters. Do you say I am still responsible for the power and equipment on this division?" "Yes, just as much as you ever were." How am I going to know what is going on? I don't see what has been done." "Well, has there been any kick? Has anybody found any fault with your work?" "No, but they might." "Well," I said, "it seems to me we are railroading now rather than running a bureau of correspondence. The fact that you could be on the road five days last week was a pretty good thing for the company. We expect your expense accounts will increase under this system. But you came back home and found so little to do that you can get out on the road again. Remember, we have a very elaborate filing room in there, with three clerks in charge of it." When we pooled all these clerks we found we had so many we gave the file room preferred attention. "Now, if you are interested in ancient history, and last week is ancient history and should afford very valuable lessons, why, take a day off and go into the filing room or send for these papers, study them to your heart's content. But we have made them ancient history.

Well, that particular master mechanic, who was a very strong man, was a little slow in coming across, but a few weeks afterwards the director of maintenance and operation came out over the road. At that time the general offices were not re-organized. The general officers were there to meet him for an inspection trip, and this mechanical assistant superintendent happened to be there and was presented as the master mechanic of the division, Mr. Kruttschnitt said, "Excuse me, you mean the mechanical assistant superintendent." He said, "Yes." Thereupon Mr. Kruttschnitt in his very nice way proceeded to ask the old master mechanic a number of transportation questions, as to what movement they were having, and what the morning weather report showed, and the crop situation, all transportation questions. Well the master mechanic from that time on has taken much more interest in transportation. Do you mean to say, gentlemen, that he is neglecting his power and equipment because he is doing these things? We think not.

Then the superintendent got down to the old traveling engineer and said, "What have you been doing?" He said, "You told me to go out on the west end and see what was delaying the through freight. Now I have been out riding the through freights on the west end, and I find the trouble

is with our train dispatchers." It is always somebody somewhere else. "The trouble is with our train dispatchers, they don't keep the way freights out of the way of the through freights. We had frequent delays on the main track while the local switched in front of us." He said, "You did? Now, you had equal rights. Why didn't you go up there and tell them to back in and let you by?" The old traveling engineer said, "I suppose under this organization I could do that." He said, "Why, certainly, you are an assistant superintendent." While I was sitting there listening my mind stopped, but the superintendent beat me at my own game. He said, "When you got back that night did you go to the dispatcher's office and arrange for it not to happen the next day?" "No, I thought I would come in and tell you about it." There, gentlemen, is too frequent a habit, lay it on to the fellow over there, pass it up to somebody else. The superintendent said, "Now, gentlemen, this applies to you all. Don't forget to tell me these things. I must be wise to keep our superiors posted, because I am responsible What I would prefer to hear from all of you gentlemen is that something was out of line and you had fixed it up." After attending that meeting, gentlemen, I had no doubt as to the success of our new system of organization.

To give you one more concrete case of a particular division. The master mechanic was nearly two miles away at the shops, and he told me that he usually spent Saturday and Sunday writing fifty or a hundred letters. It is a very heavy division. The master mechanic did not get moved over, there was a little delay. Finally one afternoon the superintendent called him up and said, "I want you to move this afternoon." He said, "I cannot. I have got to get out my pay rolls." He said, "You come over here. We have some clerks we will lend you and help you with your pay rolls. We are all one office now. There will be some drays at your office at two o'clock for you to move over here." So he moved, and this man lined up so well that he is now a mechanical assistant general manager instead of a mechanical assistant superintendent.

The assistant superintendent of the division was an old locomotive engineer who had worked up to be traveling engineer, train master, and then assistant superintendent. They said, "He has not had much office experience, and we are afraid he will fall down." "Well," I said, that is up to you all. I don't meddle in personnel. But I hate to see this good old faithful man run round, and that is what it means. If you run round him, do it with your eyes open." Then they decided to put him in the office, He said to me, "This makes me sweat blood, but I think I will get away with it." That was two years ago in August. Recently he told me, that now he had been promoted to be division superintendent, he would not be without that experience, because he was able to take right hold as a superintendent. He knew all the ins and outs.

Three times one Saturday when, after they had been running about a month, I found it convenient to go back and spend a day with them, I caught the old master mechanic in the office talking things over with the senior assistant, which is just what we want. Along in the middle of the afternoon the senior assistant threw over to me a letter that this mechanical assistant had just brought in, and said, "Do you think that Jim here needed to write that letter?" I said, "It looks good to me . What are you kicking about?" He wanted him to move an outfit car. "Don't you want these cars to move?" "Well," he said, "you know you told us that one record in the office is enough. Now, I handled a letter from his this morning to his foreman, telling him to move this car. I would have moved it anyway, but if he was afraid I would forget it don't you think it would have been enough if he had made a notation on the carbon of that letter to remind me to move it?" "Well," I said, "you are dead right. You are beating me at my own game. That is what we want." The mechanical assistant caught the spirit of the occasion, and he said, "Well, you caught that one, but there were three this morning you did not get. Next time I won't write them."

I neglected to explain one feature, gentlemen, that in-coming and out-going correspondence is supposed to go over the desk of this senior assistant for his information. There has been considerable apprehension among railroad men as to that feature. They have felt that we have frozen out the other division officers, that their identity was lost. That is not the case. If the old division engineer or the old division road master is in town and wishes to give some instructions, we will say to his track supervisors—we call them road masters with us—he writes his letter just as he always did, signs it with his own name. Before it goes out of the office it should go over the desk of this senior assistant for his information and review. Ordinarily he just writes it and it goes out. You might say this is very perfunctory; it often is, but it is astonishing how much you can recall of anything that you have once seen. Somebody has said that after we are twenty-five years old all education consists in knowing where to look for things. This fellow knows where to look for it, anyway.

Now, this may happen. He has full authority to hold that up, because he is the senior. He may call in this man and say, "Here, those instructions are all right, but the superintendent has in mind issuing some instructions that will cover all employees. Now, there is no use of your putting out instructions this week and the mechanical assistant putting out some others in a day or two. I will hold this up. The superintendent will put out some instructions that will cover it all." Or here is what we want him to say. "Remember what Abraham Lincoln said: 'When very angry write your letter, but don't mail it till to-morrow.' I will hold up this letter till to-morrow, and if you still want it mailed we will mail it." It takes a little of the sting out.

Then, too, we find it extremely persuasive. The very fact that this letter is going to be reviewed makes the man less anxious to write. Under the old order of things the tendency—mind you, gentlemen, I am speaking only of tendencies—is for the old division engineer or road master to go down the road, and rather than take the trouble when his foreman tells him something to make a note of that or to charge his mind with it he will say, "All right, write me a letter about it," and the foreman will write a letter and get it in the mail. Under the new order of things, knowing that somebody else is going to see the letter, the official says, "You need not bother to write me about that, I will be down and talk it over with you," which is just what we and have less letter writing about them. We want the human touch. And that is working out just exactly as we want. We want to talk these things over on the ground expected.

Suppose, though, that this division officer is out on the road, and it becomes necessary to give some instructions to the subordinates out on the division. Perhaps the instructions have come from the general manager himself. There is not any question of technical opinion involved, the time has come to do something. Important as that maintenance assistant is, we don't wait for him to come back on such a matter, neither do we go through the farce of signing his name to something he has never seen, under the mistaken theory that that will build up. In that case the instructions are prepared, probably by his old chief clerk, who is now an assistant chief clerk in the office, and they are signed by this senior assistant himself, the man down below being instructed, as in train dispatching, to run by the order which supersedes the previous order.

There, too, we say to them in the beginning, "Gentlemen, you are not a lot of school boys, you are experienced and tried officials. We have given you principles here, and a general working scheme, but we trust to your judgment to carry it out. If you are in town, Mr. Mechanical Assistant and you want a letter to go on a particular train, and the senior assistant has gone up town to bail a friend out of the police court, why, don't wait for him to come back, send this letter on that train and tell him about it when he comes back, call his attention to the matter. In other words, we are not laying down a lot of foolish rules to hamper you, we are giving you principles to work by." And that part of it works out very satisfactorily. It has worked so well on the divisions that we have extended it to the higher offices, that of general manager, and where we have districts to general superintendents' districts. There are two of our properties now where the system is completely carried out, one of the larger ones and one of the smaller.

At Portland, Ore., we have eight assistant general managers. Normally three of those assistant general managers are on duty at headquarters. The senior, No. 1, who was formerly the general superintendent, is the chief of staff in charge of the office, and he directs things generally, and we do not attempt to have him see every letter. Then there is another man, who happens in that case to be the old chief clerk, who is the junior assistant general manager and assists generally with a whole lot of the routine correspondence. Then the old superintendent of car service handles the equipment. If any one of those gentlemen is called out of town, as the chief of staff may be called to a rate hearing, the other two do the work for that particular day or days. That does not present any great difficulty. But remember we have five other assistant general managers we could call on.

There comes in another feature of the system that has not been generally understood. The system provides for rotation in this chair of senior assistant. The unwritten law is that whoever occupies that desk is the senior of all the others for the time being, which we find in churches and lodges and various organizations. There is an application of the idea of temporary rank. That man is senior to all the others for the time being. On some divisions there has been more rotation than on others. We hear objections to rotation, but on running them down we find they are on divisions where they have not rotated. There may have been a spasmodic attempt for a few days, or something of that sort, but not a real rotation. I found at Tucson, Ariz., week before last, an excellent example of rotation. That is one of the smaller jurisdictions, with three assistant general managers. The junior of the three is the old engineer of maintenance of way. On a recent inspection trip he was thrown off a motor car and had his leg broken. Now that he is on crutches he is running the office, and running it very well indeed; the other men are out on the road. Some of the organizations are deliberately rotating the men for the experience that they may obtain. I happened in at one point in Texas where the third man on the list, the old master mechanic, was on the lid as we call it, and he said, "It is the hardest job I ever tackled. I never knew before that there was so much about a railroad." He was handling the correspondence about the telegraph line, the bridges, and everything of that sort. Now, as an experienced man and a sensible man of long service don't you suppose when he went out on the road again that he took a little more interest in those things then he did before? If we did not lose anything all that we got from him was that much velvet.

Some people have felt that it was not worth while to go to all this trouble, that we did not get increased supervision on the outside. We have yet to find a case where any activity has suffered by reason of a broadened authority. That is, the maintenance assistant does not tell us that the track is run down, because he is performing the transportation duties. We tell him in the beginning, "It is up to you for the maintenance," but as in the case of the maintenance assistant when the crossing was blocked he could not inspect very much track until they started again. He could open that crossing and look over his side tracks while the train crew was switching. There comes in the adaptability of the man. We feel that the moral effect of an officer on the spot whose authority cannot be questioned is well worth all the trouble that we have taken.

And here is the point that I would endeavor to impress upon you most of all, that is, this has been done with the talent at hand. We said, "We cannot afford to demoralize the service by letting out any of these faithful old officers simply because they cannot do some of the fancy stunts. We will tell them to go to it and be satisfied with what they do." And right here is the principle involved, gentlemen. When a man knows just what is expected of him, when his hands are untied and when he is given authority, he after all is the best judge of his performance. When he has done the very best he knows how, and you have reason to believe that he is doing the best he knows how in accordance with the light that you have given him, then you must be satisfied with the result. You cannot get the results by writing him a letter afterwards and telling him all the numerous things that he might have done, and that we are trying to cut out.

Discussion By Prof. W. J. Cunningham, Harvard University.

I had read a great deal about the unit system, and in deciding upon a specific subject for study I chose it as its introduction on the Harriman Lines seemed to mark an important epoch in the development of railroad administration. Railroad progress has proceeded more along technical and operating lines than in the regulation of administrative affairs, that is, in taking account of the human element. The maximum limit for large locomotives, large capacity cars, increased speed, heavy tonnage, etc., has pretty nearly been reached but in the field for increased efficiency in the human element there is a great field for development. Therefore, it seemed to me that the plan which Major Hine has elaborated would certainly justify a summer's study, and I am very glad indeed that the topic was chosen. I spent about two months on the Harriman Lines, and traveled over all of the lines except those of the Southern Pacific-Atlantic System and its lines in Mexico. I found a great deal of enthusiasm over the results which have followed the introduction of the unit system. As I view it the important facts which differentiate the unit system from the ordinary divisional plan of organization are, first, a consolidation of offices and making a common office for all the division subordinates; second, the principle of having the senior assistant (chief of staff) at headquarters at all times,—an experienced man, a man with outside knowledge "on the lid," as they term it, at all times,—and, third, the principle of co-ordination of rank and authority, that is, the elimination of distinctive titles making each division officer an assistant superintendent, co-ordinate in authority and with the same title.

On the first principle, of consolidation of offices, there was a unanimity of opinion as to its marked success. In every office that I visited, and I saw most of the division offices, they were all heartily in favor of the consolidation of the files, and pooling of the forces. The results were quite satisfactory. The principle of substituting conference for correspondence works out well. In some of the offices where I spent considerable time, and where the files were opened for my inspection, a look was enough to demonstrate the practical advantages. A file that under our ordinary form

of organization would have been voluminous with much duplication, would, with the elimination of inter-office correspondence, be about one half the usual size. I think the Major is quite modest in stating that the reduction in correspondence runs from 30 possibly to 50 per cent.; it seemed to me that 50 per cent would be a closer estimate, because the reduction in the correspondence between the offices was very distinct. In one office in particular, where I spent considerable time, the practice of having frequent conferences was followed. The division superintendent's private office was flanked on each side by the private offices of his division subordinates, and the majority of matters which came up for determination were handled right "off the bat," without a scratch of correspondence. The division superintendent would call in the former master mechanic and the division engineer, and the decision would be made whether the work should be done or not, whether the change should be authorized or not, or in case of having to refer it to higher authority a letter would be written right there and then. In the office of one superintendent there are now something like seventy men, the consolidated forces of the former division master mechanic, the master car repairer, the division engineer, the train master, the chief train dispatcher, the division storekeeper, the signal supervisor, the road master, and I believe the superintendent of bridges and buildings. I may have omitted some, but it made a very formidable looking array of clerks, yet everything was so systematized and worked so smoothly that to see was to believe.

On the second principle, of having a senior assistant at headquarters at all times, there was also a decided unanimity of opinion as to the desirability and as to the advantageous results. It practically means, as I understood it, an extra expense in a great many divisions, because the senior assistant, or the man who took his place outside, is an extra official, but there was no doubting the justification of the extra expense on the score of increased supervision and the substitution for what Major Hine calls "rule by chief clerk," by having the correspondence handled by a man with a broader experience. I have thought that the Major was a little hard on the chief clerk. The chief clerk, I believe, deserves more consideration than he is usually accorded. We should not shoot the fiddler, because he is doing the best he can. But the Major I think has to-night paid a deserved tribute to the chief clerk, and blames the evils he mentions on the system rather than on the man. The fact that in many cases the former chief clerk is now the senior assistant superintendent under the unit system shows that he really is the man for the place and that he has justified his existence.

On the third principle, that of co-ordination of rank, title and authority, there is not a the present time—or at least was not last summer—the same unanimity of opinion or the same sympathetic support which I found with respect to the wisdom and expediency of the first and second principles. This is probably due to the fact that the opportunities of the system are not fully appreciated nor understood. Possibly, too, there is a sort of an undercurrent of feeling that the system is "on trial,"—that it may not be permanent. I understand now that these negative influences are being corrected,—that the organization is hewing closer to the line, and that there is no question in the minds of the management as to the permanancy of the system.

As I view it, the full fruits of the new system cannot be attained with the present generation of assistant superintendents. A new generation must be trained to bring out its possibilities. Present results are regarded as satisfactory, but not as satisfactory as the originator of the system and the higher authorities have a right to expect. There is a little feeling of resentment in the technical departments against the loss of distinctive title. From their attitude it is plain that they take more professional pride in being a master mechanic or a division engineer than in their new indistinctive role of assistant superintendent. Possibly Major Hine will be willing to touch upon this point in closing.

To a person whose knowledge of the system is confined to reading about it, there always occurs the thought that this overlapping of authority must bring clashing and ill feeling. It is reasonable to assume that such would be the case but I saw none of it and heard of no trouble on that account. Possibly this happy condition is due to the timidity of the officials to exercise their broadened functions and their fear of the consequences if they should venture outside their own assignments and the fields in which they have become experts. They are still specialists in their own particular assignments and departmental lines are clearly in evidence although officially broken down.

It seemed to me, as I viewed the situation last summer, that if one feature more than any other needed the constant attention of Major Hine and the executive officers it was the tendency to continue to do business outside of the offices just about the same as was done under the former system. In other words, it seemed to me that the subordinate officials were not measuring up to the new opportunities and responsibilities. There was little inclination to borrow grief by "butting in" on the assignment of the other fellow. The men were not courting trouble by extending their activities to lines of work with which their previous training had not made them familiar.

But after all, the fundamental principle of the system is to afford a broader training to the division subordinate officials and to increase the number of men of the proper calibre for superintendent. The system certainly affords that opportunity. If, as it seemed to me last summer, its opportunities are not embraced as they should be, the criticism is not on the system but on its operation. An apparent weakness, it seemed to me lay in the failure to couple responsibility with authority. An assistant superintendent normally assigned to certain major duties seems to feel that his authority to act does not carry with it an obligation to act in another department. Therefore there is not the same stimulus to reap the full theoretical advantage of the co-ordination principle. But conditions may have changed somewhat in six months and Major Hine states that there is a greater willingness on the part of the division officials to broaden out.

Personals

Harvey Derne succeeds G. W. Litz as general manager of the Big Sandy & Cumberland, with office at O'Keeffe, W. Va.

F. A. Neale has been appointed general foreman of the Central R. R. of New Jersey, to succeed E. A. Detro, with office at Jersey City, N. J.

H. B. Earling, formerly general superintendent of Chicago, Milwaukee & St. Paul, has been made assistant general manager, with office at Chicago. W. S. Cooper, P. C. Eldredge and J. H. Foster now have the title of general superintendent.

A. E. Rawson has been elected president and treasurer of the Chicago River & Indiana to succeed Frank Donnelly. His office is at the First National Bank Bldg., Chicago.

A. C. Ridgway succeeds the late F. O. Melcher as vice-president in charge of the operating department of the Rock Island, with office at Chicago. W. S. Tinsman has been appointed assistant to the president at Chicago, and he is succeeded as general manager of the first district by W. M. Whitenton. Mr. Whitenton's office is at Chicago. C. W. Jones has been promoted to general manager of the third district, with office at Ft. Worth, Texas. F. J. Easley

succeeds Mr. Jones as general superintendent of the first district, with headquarters at Davenport, Iowa.

The Colorado Springs & Cripple Creek District Ry. has been leased and is now operated by the Florence & Cripple Creek R. R.

A. J. Hodge has been appointed master car builder of the Fourche River Valley & Indian Territory Ry. to succeed J. A. Chapman. His office is at Bigelow, Ark.

H. W. Wheatley has been appointed road foreman of engines of the Grand Trunk with office at Montreal, Que. He succeeds F. Payette.

J. C. Benson succeeds J. L. Miller as master mechanic of the Great Northern at Grand Forks, N. D. A. L. Wenstrom has been appointed foreman painter at St. Cloud, Minn. T. F. Markley succeeds P. Cebula as car foreman at Fargo, N. D.

C. D. Minard has been appointed master mechanic of the Iowa & Illinois with office at Clinton, Ia. He succeeds J. F. Greenleaf.

A. Ross has been appointed superintendent of the New Jersey and Lehigh division of the Lehigh Valley with office at Easton, Pa. D. Oxenford succeeds J. H. Mason as road foreman of engines at Jersey City, Pa.

J. A. Banks has been appointed purchasing agent of the Macon & Birmingham, vice J. H. Palmer. His headquarters are at Macon, Ga. Mr. Palmer becomes superintendent of the St. Johns River Terminal at Jacksonville, Fla.

L. F. Couch is now master mechanic of the Memphis, Dallas & Gulf with office at Nashville, Ark.

Chas. Gilbert succeeds E. C. Overstreet as purchasing agent of the Missouri & North Arkansas with office in the Security Bldg., St. Louis, Mo.

Arthur Herrick has been appointed master mechanic of the Mississippi, Hill City & Western with office at Hill City, Minn., to succeed B. B. H. Johnson.

S. S. Arentz, formerly chief engineer of the Nevada Copper Belt has had his title changed to general superintendent. His office is now at Ludwig, Nev.

The office of R. H. Howard, general manager of the New Orleans Great Northern, has been changed from Bogalusa, La. to Jackson, Miss.

C. E. A. Carr has been appointed general manager of the New Orleans, Southern & Grand Isle with office at New Orleans, La.

M. S. Hawkins, secretary of the Norfolk Southern, will succeed to the duties of assistant to the president, vice, H. C. Hudgins, retired. His office is at Norfolk, Va.

H. B. Earling.

T. S. Davey has been appointed master mechanic of the New York, Susquehanna & Western with office at Stroudsburg, Pa.

Edw. Rice has been appointed master mechanic of the Northwestern Pennsylvania with office at Meadville, Pa., vice, Wm. Weisman.

W. S. Jones succeeds R. J. Quimby as master mechanic of the Payette Valley with office at Payette, Idaho.

R. B. Fowler has been appointed superintendent of the St. Louis, Brownsville & Mexico with headquarters at Kingsville, Tex.

W. C. Meyers has been appointed assistant master mechanic of the Southern Pacific at Atlanta, Cal.

Frank H. Davis succeeds the late Edwin Hawley as vice president of the Toledo, St. Louis & Western at New York.

J. T. Carroll.

J. T. Carroll has been appointed assistant general superintendent of motive power of the Baltimore & Ohio with office at Baltimore. E. J. Searles succeeds Mr. Carroll as superintendent of motive power at Pittsburgh. T. C. O'Brien has been appointed motive power inspector to succeed J. F. Franey, with office at Pittsburgh. C. E. Lester has been appointed assistant master mechanic at Glenwood, Pittsburgh. O. K. McQuen succeeds E. F. McCafferty as general foreman locomotive department at Weston, W. Va. H. L. Miller has been appointed general foreman car department at Keyser, W. Va. and F. M. Garber has been appointed to fill a like position at Garrett, Ind.

R. P. Moore has been appointed purchasing agent of the Duluth & Iron Range with office at Duluth, Minn. He succeeds Fred H. White, who becomes purchasing agent of the Duluth Missabe & Northern at Duluth.

Milton S. Barger has been appointed treasurer of the New York Central Lines, west of Buffalo, to fill the vacancy caused by the recent death of Charles F. Cox, His office is at New York.

E. J. Wheeler succeeds Wm. Hansen as general car inspector of the Chicago, Burlington & Quincy, Lines West, with headquarters at Lincoln, Neb.

W. J. Crandall has been appointed a master mechanic of the New York Central & Hudson River with office at Rochester, N. Y.

W. P. Carroll has been appointed a master mechanic of the New York Central & Hudson River, with office at West Albany, N. Y.

S. J. Delaney has been appointed an assistant master mechanic of the New York Central & Hudson River, with office at West Albany, N. Y.

M. H. Strauss has been appointed a master mechanic of the New York Central & Hudson River with office at New Durham, N. J.

Among The Manufacturers

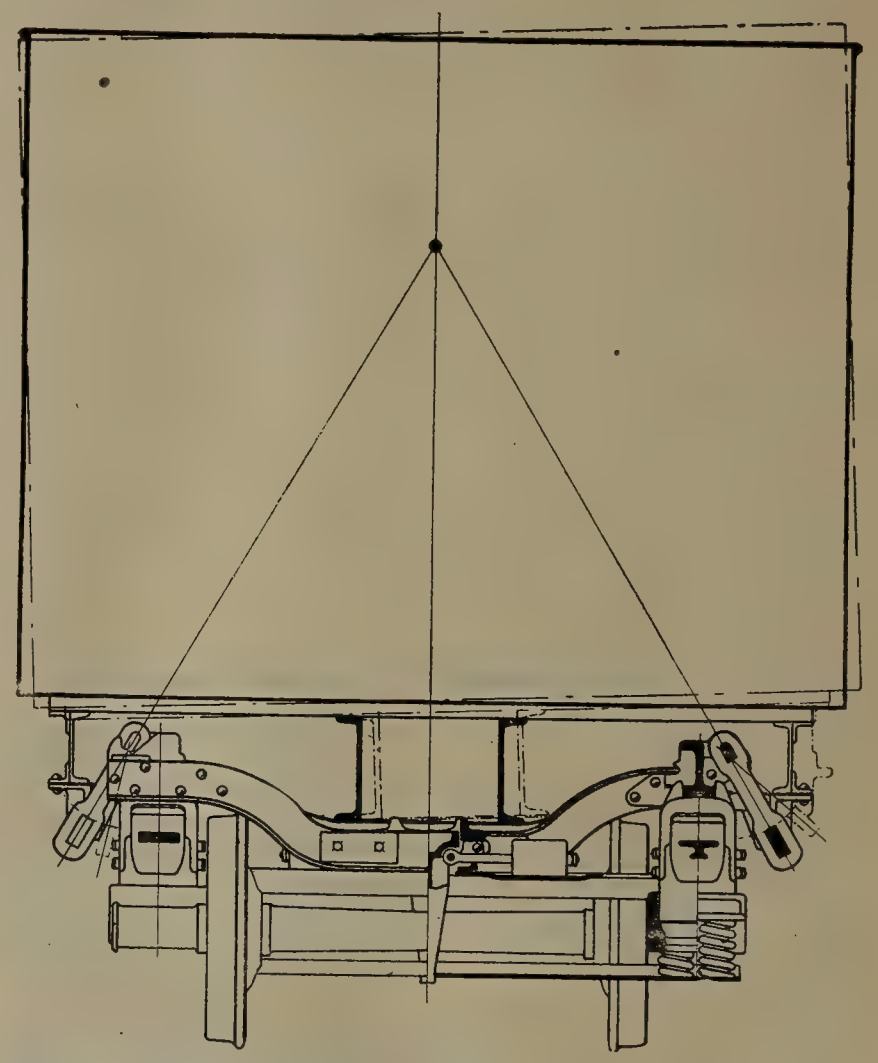
SUMMERS STEEL CARS.

The Bessemer & Lake Erie has ordered 100 all-steel box cars of the Summers Steel Car Co., of Pittsburgh. They are to be of 100,000 pounds capacity, equipped with rolled steel Shoen wheels and the journals are 5½x10 ins. The Summers balanced side bearing trucks are to have arch bar truck side frames, cast steel side bearing rockers with forged steel hanger bars and Z-bar cradle construction, as shown in Fig. 3. The dimensions of these cars are as follows:

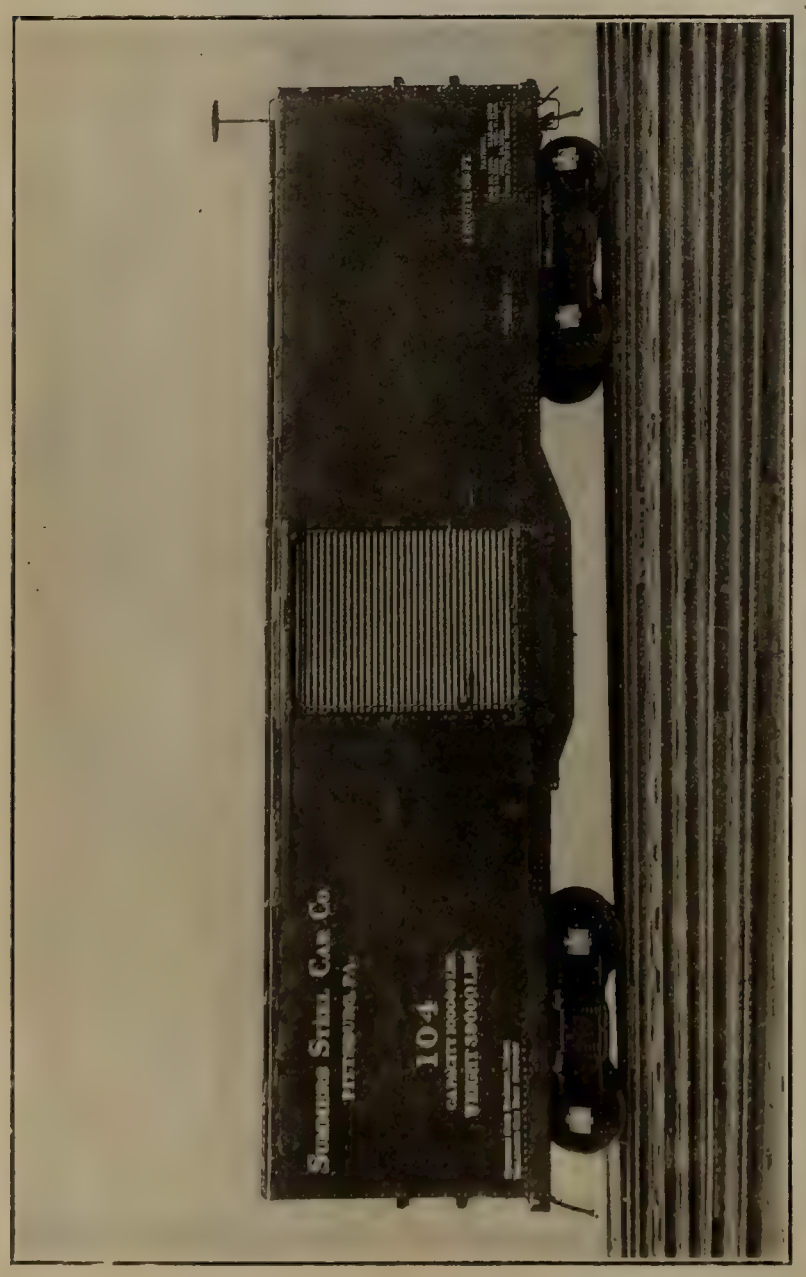
Length inside in clear	40 ft.
Width inside in clear	8 ft. 10⅜ ins.
Height, top of floor to underside roof	8 ft. 10 ins.
Height, top of rail to floor (light)	3 ft. 6¾ ins.
Wheel base of truck	5 ft. 6 ins.
Weight, complete	43,000 lbs.

FLEXIBLE STEAM CONDUIT.

A flexible permanent connection for steam and air is being put on the market by the Jos. Goetz Mfg. Co., of Toledo, O. These conduits are used as steam heat connections between passenger cars in place of rubber hose. They are of all metal construction and guaranteed against leakage. It will be noted in the illustration that there is a chain attached to the coupling head. This chain prevents the head from falling low enough to be knocked off when in an uncoupled position, and

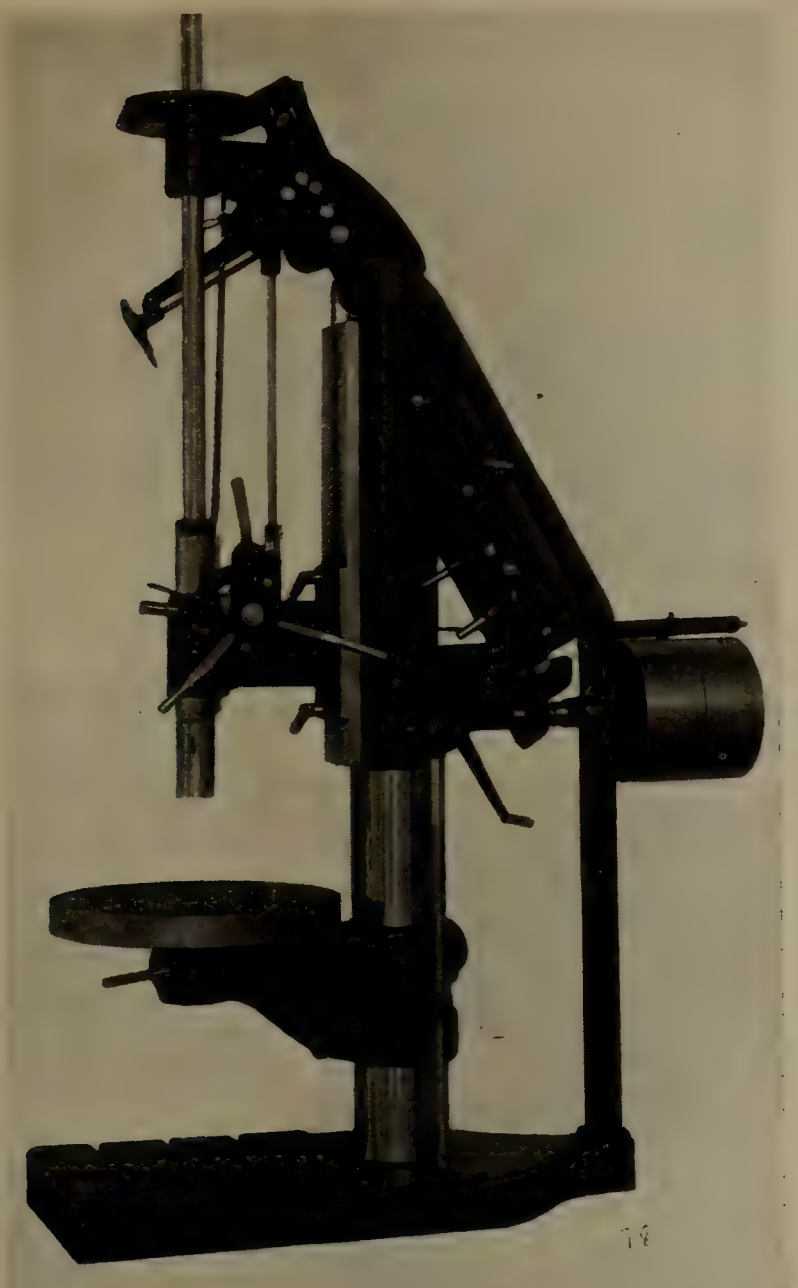


Summers Balanced Side Bearing Truck on Locomotive Tender.



Summers Steel Car.

Goetz Flexible Steam Conduit.



Barnes Standard Sliding Head All Geared Drill.

it also acts as an automatic release, there being 2½ inches of slack in it when in normal position. When cars are parted and the heads not uncoupled by hand, the chain uncouples them automatically, drawing the heads out of each other. These conduits can be used in connection with rubber steam hose where the same style of head is used.

They are pressure packed and will seat themselves to such an extent that they will not leak at one-half pound pressure. They will take any motion subjected to them without leakage, and they are said to be much easier to couple and uncouple than rubber steam hose.

ALL GEARED SLIDING HEAD DRILL.

The Barnes Drill Co., Rockford, Ill., has recently placed on the market one of the most unique, powerful and generally useful drills available for railway shop use. The illustrations show two views of the machine. In one of these views the drill is shown with special equipment for boring, sizing and reaming exhauster bodies for the Atwood Vacuum Cleaner Co., Rockford, Ill. The boring heads are equipped with pilot bars in order that the same machine may be used in this case for boring bearings. The sliding head, which is raised and lowered quickly by means of a rack and pinion, fits in very nicely with this equipment, for it makes it possible to easily place and replace the tools.

This all-geared drill is a developed machine tool, essentially original in design and of unusual strength and power, representing the result of many years' experience in drill building. It will properly handle the modern high speed twist drill and has many operative features which assure maximum output at minimum cost, as an element of wasted time is eliminated. It has geared speed changes and geared power feeds. All changes of feeds and speeds, including the back gears, are made instantly while the machine is running.

The operator, standing in front of the drill, is within reach of all change levers. No time is lost on account of slipping cone belts, or in walking around the machine to shift feed and speed belts, or in stopping to lace them.

The 26-inch sliding head all geared drill is a machine of remarkable strength and power. There are eight geared speeds and eight geared feeds, all under instant control from front of the machine. Feeds are shown in plain figures and range as follows: .005-in., .008-in., .012-in., .018-in., .024-in., .041-in., .056-in. and .086-in.

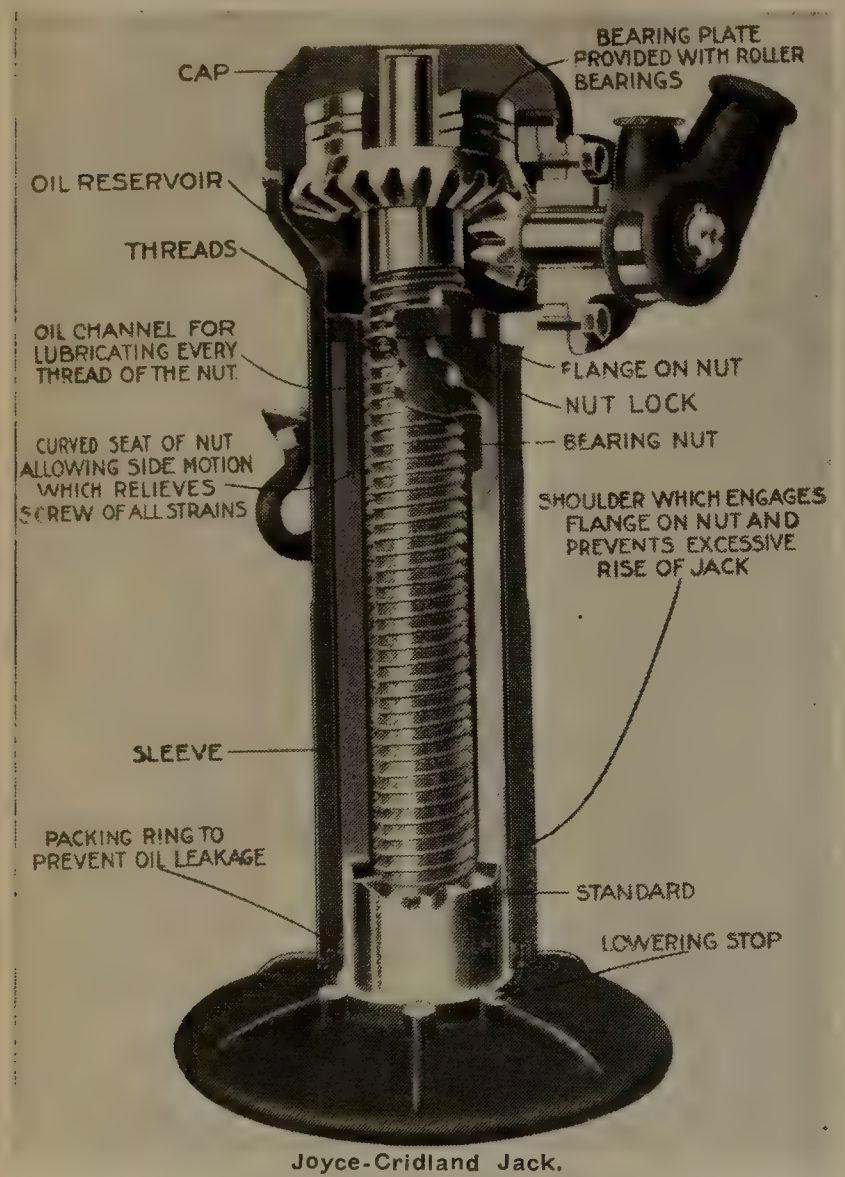
The spindle is exceptionally large (1 15/16-in.) and double splined. The sleeve has 14-in. travel and drift hole is below the sleeve. The crown and pinion gears are cut four-pitch and are of extra large diameter, making them very strong and powerful. Head and spindle are counterbalanced, the weight being suspended by roller bearing sheave wheel. The other sheaves are accessible to oil. The head is gibbed to the column face, insuring perfect alignment, and is held at any point within the long travel by two quick acting clamp screws.

This machine is guaranteed to drive a 2-in. high speed twist drill at .041-in. feed per revolution of spindle or at the rate of 6½ ins. per minute in cast iron, without the back gears. It drives a 1-in. high speed twist drill at the rate of 13½ ins. per minute in cast iron, provided the twist drill will stand up.

Barnes Sliding Head Drill Equipped with Boring Attachment.

"J. C." GEARED SCREW JACKS.

The Joyce-Cridland Co., Dayton, Ohio, is marketing a line of geared screw jacks which merits unusual interest. It is admitted that the screw jack is perhaps the least efficient of all mechanical movements. It is popular because, when well designed, it forms a safe support for the load


CAP
BEARING PLATE PROVIDED WITH ROLLER BEARINGS
OIL RESERVOIR
THREADS
OIL CHANNEL FOR LUBRICATING EVERY THREAD OF THE NUT
FLANGE ON NUT
NUT LOCK
BEARING NUT
CURVED SEAT OF NUT ALLOWING SIDE MOTION WHICH RELIEVES SCREW OF ALL STRAINS
SHOULDER WHICH ENGAGES FLANGE ON NUT AND PREVENTS EXCESSIVE RISE OF JACK
SLEEVE
PACKING RING TO PREVENT OIL LEAKAGE
STANDARD
LOWERING STOP

Joyce-Cridland Jack.

lifted by its lever. As the efficiency of the screw increases in proportion to the increase of the pitch of the thread, some designers have, in some of the common types of jacks made attempts to take advantage of this fact by using very coarse threads. When this is done the tendency is toward an angle at which the friction between the surfaces on the thread of the nut and the screw is not sufficient to prevent the screw from sliding down in the nut, and lowering the load.

The "J. C." jack was designed with the purpose of giving the highest possible speed consistent with safety. The angle of the thread has been made just enough less than that at which the load would slide down the inclined plane to insure the screw remaining stationary in the nut. The teeth on the bevel gear are of the stubb type and of bracket form. This form reduces the end thrust on the bearing.

The jack is so designed that the working parts can be removed through the top of the jack without taking the sleeve off the standard. The nut is locked in place, which prevents its being pulled out when the jack is carried or handled.

A flange, with which the nut is provided, extends beyond the standard, and the sleeve at its lower end slides snugly on the standard. Thus, when the upper edge of the shoulder, which is formed by the smaller bore at the lower end of the sleeve, has come to this protecting flange of the nut, there is a positive stop.

By special design there has been provided a system of lubrication which does away with all wear and tear of the thread and other working parts, unnecessarily caused by too much friction. At the lower end of the sleeve is a packing ring, forming a liquid tight joint between the sleeve and the standard. This permits the jack to be filled with oil in which the screw, gearing, rollers and roller plates work. Besides this, a hole, drilled lengthwise of the nut, forms a passage communicating with each thread and the oil reservoir, so that as the screw runs up or down, the oil runs through this passage and between the threads as they pass it.

Nickel Chrome Steel is used in making the standard, housing, cap and bevel gear. For the screw, which must be efficient, and the bevel pinion, ratchet wheel, top bushing for the screw, and bushing for pinion bearing 40 per cent carbon steel has been selected. The hardest and toughest aluminum bronze is used in the nut. The roller bearings and roller plates are made from a special alloy steel, which has been selected after endurance tests.

COMBINATION DYNAMOTOR-COMPRESSOR.

The Westinghouse combination dynamotor-compressor shown in the illustration is a device for use on 1,200 and 1,500-volt direct-current motor cars and locomotives; it performs the functions of both dynamotor and compressor, furnishing half voltage for the operation of the control and lighting circuits, and in addition drives the air compressor when necessary. The dynamotor is connected between trolley and ground, and operates continuously. When the air reservoir pressure falls below a certain predetermined value, the compressor is automatically connected to the dynamotor by a clutch. When the compressor raises the air pressure to a predetermined maximum value, the clutch is automatically disconnected and the compressor stops.

The usual arrangement for 1,200 and 1,500-volt equipments consists of: (A) a high or low voltage motor for operating the compressor, and (B) a continuously running dynamotor for supplying current at half voltage (600 to 750 volts) for lights and control, and for the low voltage compressor motor, if such is used. The Westinghouse dynamotor-compressor performs the duties for which the two machines were formerly required and as a result, there is a saving of about 900 pounds in the weight of the equipment, and there are fewer parts and only one machine to maintain.

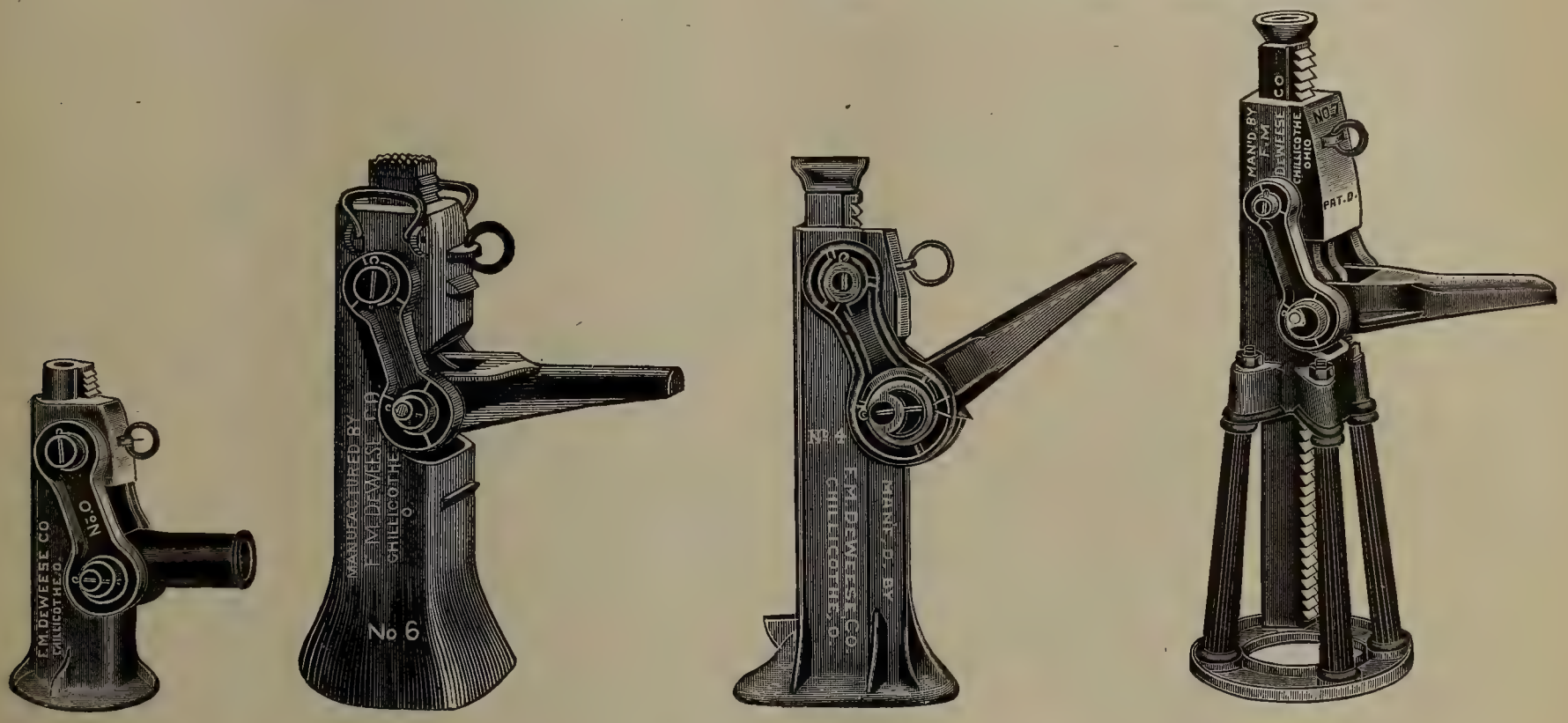
In sections where the trolley voltage is 600 or 750 the dynamotor connections are changed by throwing a canopy switch, so that the dynamotor becomes a compressor motor operating on one winding on half voltages and at normal speed thus driving the air compressor at normal speed. Full air pressure is therefore assured on all interurban and city sections. The straight 1,200-volt motor-driven compressors operate at only half speed when on the half voltage sections

Dynamotor-Compressor Installed in Electric Locomotive.

of a road, and are often incapable of delivering sufficient air to provide for the frequent city stops.

The dynamotor has two separate armature windings on the same core, each connected to a commutator. When the dynamotor is connected across 1,200 or 1,500 volts, the two windings are in series, so that each takes one-half of the trolley voltage. Each armature winding is in series with a field winding. A shunt field winding is connected across the leads of the low voltage armature to maintain the speed approximately constant.

The magnet frame is a single piece of steel casting. Large openings, closed with bearing housings, are provided at each end of the frame, through which pole pieces, field coils and armature can be removed. Tight fitting commutator hand hole covers are funrnished. These have machined seats and easily operated locking levers. Dynamotors and compressors are machined to templet and are interchangeable. Field coils are vacuum impregnated with a water-proof and heat-proof compound. Metal coil shields provide protection and spring coil supports prevent vibration and chafing.



Mcsher Patent Lifting Jacks.

MOSHER JACKS.

The Mosher patent lifting jack has been on the market for a number of years and in that time has made many friends. It is manufactured by the F. M. De Weese Co., Chillicothe, Ohio. The inventor, S. Earl Mosher, filled several positions in railroad work, thus gaining a knowledge of the needs of the men in various branches of the service. The jack he invented is the result of years of careful study spent in simplifying without losing in strength and efficiency, and in the perfected product we find sizes adapted to every branch of work, and in such form as to be easily handled and kept in condition by the common laborer.

The car inspector's jack, Number 0, weighs 19 pounds, raises 6½ ins., with ¼ in. notches, and has a capacity of 8 tons. It is used extensively by the government in the Mississippi River Commission at New Orleans. Number 1 is a journal jack, weighing 25 pounds and having a capacity of 12 tons. The notches are ⅜ in. and its raise 6 ins. Numbers 2, 3 and 4 are track jacks, with foot lift, and vary in raise from 10 ins. to 15½ ins., and in size of notch from ⅜ in. to 1 in. Their capacities are 12 and 15 tons. Number 5 has proved itself a most popular size, being used for heavy car and locomotive work, on bridges, and for wrecking. It raises 12½ ins., by ½ in. notches, weighs 96 pounds, and has stood working tests of more than 30 tons. It has a foot lift. Number 7 is another very popular style, which, though designed for a coach and sleeping car jack, is used extensively by wrecking crews in all classes of work. This and Number 5 are specified by the government on its requisitions for the Panama Canal Commission. Number 8 is a light track jack, weighing only 24 pounds. It has a ground lift, and has proven itself useful in many instances where more than 10 or 12-ton capacity was unnecessary.

Especial attention should be given Numbers 6 and 9, which are made to meet the demands for heavy work, as they have been tested to more than 35 tons. Number 6 is fitted with handles to facilitate carrying it about and Number 9 has a foot lift. Number 6 raises 13½ ins. and Number 9 15½ ins., both by ½ in. notches.

All of these jacks are similar in principle, having a stand or body in which fit all the other parts, held in place by side arms fastened with steel pins. They may be lowered one notch at a time, if desired, and are safe and reliable, being made of the best steel and malleable iron.

New Literature

A handsome booklet, descriptive of "Ferro" gas engines, has been issued by the Ferro Machine & Foundry Co. of Cleveland. It is styled "A Practical Treatise on Marine Engines," contains many excellent illustrations and is an example of high art in catalog work. It contains much matter of value to those interested in the gas engine.

* * *

The Alexander Milburn Co., of Baltimore, Md. has issued a pamphlet descriptive of the Alexander steam acetylene generator.

* * *

"Steam Tables for Condenser Work" is a hand-book recently published by the Wheeler Condenser & Engineering Co., of Carteret, N. J., which should be of practical service to those interested in engine turbine and condenser work.

* * *

The Union Fibre Co., of Winono, Minn., has issued an elaborate and comprehensive booklet on the subject insulation for railway equipment. It is divided into five chapters and contains much useful information concerning refrigerator cars, together with more particular information about Linofelt and Feltino insulation, its method of manufacture and application. It is a very readable booklet.

Industrial Notes

John B. Given, formerly sales manager of C. H. Whall & Company, Boston, Mass., has opened an office at 253 Broadway, New York, to handle railway specialties. Mr. Given is still connected with the Whall company in another capacity.

The Independent Pneumatic Tool Company, Chicago, has secured larger floor space in the Farmers' Bank building, Pittsburgh.

The Lea Equipment Company, New York, maker of centrifugal pumping equipment and the Lea-Simplex cold saws, has moved its general offices to the corner of Stenton and Wyoming avenues, Philadelphia, Pa., where its plant is located.

L. H. Mesker, in the Cleveland, Ohio, office of Manning, Maxwell & Moore, Inc., New York, has been made manager of the St. Louis, Mo., office of that company, succeeding C. L. Lyle, resigned. Frank P. Smith, formerly in the sales department of Manning, Maxwell & Moore, has again entered that department of that company, with office in New York. C. R. McCullough, of the Packard Motor Car Company, Detroit, Mich., has resigned to enter the sales department of Manning, Maxwell & Moore with office in Detroit.

E. M. Richardson has been elected a director of the Chicago Pneumatic Tool Company, to succeed Oliver Wrenn.

Taylor & Arnold, Montreal, Que., have been made Canadian representatives for the American electric headlight equipment, made by the Remy Electric Company, Anderson, Ind.

A. L. Whipple, has entered the sales department of the Ward Equipment Company, New York.

William B. Hall, superintendent of equipment of the Mather Horse & Stock Car Co., Chicago, has been made vice-president and general manager of the Illinois Car & Manufacturing Co. and the Illinois Bolt Nut & Forging Co., both of Chicago, with office in the Great Northern building.

Hubbard & Company, Pittsburgh, Pa., announce a change in the management of their Chicago office. O. W. Youngquist, of the H. Channon & Co., has been appointed manager of Hubbard & Co.'s Chicago office, with headquarters' in the Fisher Bldg.

The Hildreth-Jones Co., Monadnock Block, Chicago, announce the above Company title will be discontinued and the title of Morgan T. Jones & Co. substituted, Hildreth & Co., of New York, Philadelphia and Pittsburgh, associated. Mr. Jas. A. Lister formerly Chicago Manager of the Pittsburgh Testing Laboratory will have charge and manage the structural steel and cement departments.

The Jones Car Door Co., Chicago, has been incorporated in Maine, with $50,000 authorized capital stock. Charles L. Andrews of Augusta is clerk of the corporation.

Mr. George A. Post Jr., has been apointed western sales manager of the Standard Coupler Co., with office in the People's Gas Building, Chicago, and succeeds Mr. Charles D. Jenks, who resigned to engage in other business.

Francis H. Stillman, president of The Watson-Stillman Co., and a prominent figure in machine tool and engineering industries, died suddenly Sunday morning, February 18th, at his residence, 105 Rodney Street, Brooklyn. He was 62 years old.

The interest of Mr. E. A. Schumacher in the firms of Schumacher & Boye and Schumacher, Boye & Emmes manufacturers of engine lathes has been acquired by F. W. Boye, Jr. and W. T. Emmes who have incorporated as the Boye & Emmes Machine Tool Co., Cincinnati, O.

Charles Haines Williams, Jr., has been elected third vice-president of the Chicago Railway Equipment Co. Mr. Williams has been connected with the company since the latter part of 1897, beginning as mechanical inspector and serving in various capacities both in the engineering and sales departments. He has been identified with the manufacture of brake beams since going into the railway supply business and has been granted a number of patents and developed many well known improvements in beams.

An important deal has been consummated between officials of the Pressed Steel Car Co. and the Illinois Car & Equipment Co., of South Chicago, Ill., by which the Pittsburg company, through its subsidiary corporation, known as the Western Steel Car & Foundry Co., takes over the entire property of the Chicago concern, paying therefor $1,000,000. The Western plant of the Pittsburg company operates on orders for Western roads almost entirely. It turns out all kinds of steel freight cars. The steel passenger coach plant remains exclusively in Pittsburg.

Executive Committee Meeting, Chief Interchange Car Inspectors' And Car Foremen's Association.

The executive committee of the Chief Interchange Car Inspectors' and Car Foremen's Association met in the Great Northern Hotel, Chicago, February 10, 1912. The following were in attendance: H. Boutet, Carew Building, Cincinnati, O.; T. M. Baughan, C. G. W. R. R., Oelwein, Ia.; Chas. Bossert, Chicago, Ill.; E. R. Campbell, Minn. Transfer Ry., St. Paul, Minn.; I. N. Clark, Chicago, Ill.; R. J. Cook, C. & W. I. Ry., Chicago, Ill.; E. J. Constant, 600 Grand Central Station, Chicago, Ill.; R. E. Forbes, 600 Grand Central Station, Chicago, Ill.; J. J. Gainey, C. N. O. & T. P. R. R., Ludlow, Ky.; H. H. Harvey, C. B. & Q. R. R., Chicago, Ill.; E. W. Hartough, P. M. R. R., Chicago, Ill.; E. E. Jett, Chicago Ill.; L. J. Koeppen, C. & I. W. R. R., Chicago, Ill.; A. Kipp, N. Y. O. & W. R. R., Middletown, N. Y.; O. F. Koepp, Grand Central Station, Chicago, Ill.; F. M. Lucore, Grand Central Station, Chicago, Ill.; F. Mathews, 6127 Honore street, Chicago, Ill.; A. F. Peterson, Chicago, Ill.,; J. L. Stark, H. V. R. R., Columbus, Ohio; S. Skidmore, C. C. C. & St. L. R. R., Cincinnati, Ohio; F. C. Schultz, 600 Grand Central Station, Chicago, Ill.; A. E. Schultz, 2729 West 23rd street, Chicago, Ill.; A. S. Sternberg, Wabash R. R., Springfield, Ill.; J. F. Sommers, B. & O. R. R., South Chicago, Ill.; S. Shannan, 6732 Michigan avenue, Chicago, Ill.; F. W. Trapnell, Kansas City, Mo.; M. M. Vincent, National Car Line, Chicago, Ill.; L. R. Wink, C. & N. W. R. R., Chicago, Ill.; E. H. Wertschorck, I. C. R. R., Chicago, Ill.; C. J. Wymer, C. & E. I. R. R., Danville, Ill.

The meeting was called for the purpose of formulating recommendations for the Arbitrating Committee with respect to the revision of the M. C. B. rules of interchange; and to decide the meeting place for the 1912 annual convention.

The meeting convened with Chairman Boutet in the chair.

It was decided to hold the annual convention at Chicago, August 20, 21, 22, 1912.

Mr. Schultz suggested that Rule 2 be cut out. After discussion it was decided to hold the vote in abeyance until it could be considered further.

Mr. Trapnell suggested that the words "when necessary" be inserted in Rule 2 after the word "transfer." His suggestion was adopted unanimously.

Chairman Boutet recommended a change in Rule 32 as follows: Change Section 2, Rule 32, to read: "Defect cards shall not be required for any damage so slight that it does not require repairs; for example, edge of roof, end facia, side facia, end and side moulding, end and side door caps, end and side sheathing, side and end doors, side posts, side braces, door and corner posts, side and end stakes, side and end plates, ends of flooring, all sills, draft timbers, cross ties, dead wood, sub-sills, body bolsters, and all siding if not damaged sufficiently to impair the strength of these parts." The suggestion was adopted.

A motion was made by Mr. Kipp that the following missing material be incorporated in Rule 33: Doors or their parts, refrigerator hatch covers, buffer castings.

Secretary Skidmore read a recommendation as follows: Add to Section 2, Rule 43: "All sills, body bolsters, cross tie timbers, side stakes, end stakes, side and end sheeting, top and bottom angle irons not damaged sufficiently to impair strength or necessitate removing." The recommendation was accepted unanimously.

Mr. Trapnell recommended that, in Rule 42, covering combination of defects, damaged corner posts and end posts be omitted. This was accepted after debate by a close vote.

Mr. Campbell made a motion that in Rule 48, owner's responsibility should include refrigerator hatch covers. The motion was carried.

Mr. Kipp, at the suggestion of Mr. Boutet, moved that brake shoes and keys listed in Rule 55 be not considered a cardable defect. This motion was seconded and carried.

Mr. Cook suggested the elimination of Rule 56. Mr. Sternberg made the motion, and it was carried.

Secretary Skidmore read a recommendation as follows: In Rule 69, after the figures "78" take out "chipped flange if chip is on the throat side of flange." Change Rule 82 to read: "Chipped flanges if chip exceeds 1½ inches in length, ½-inch in width or extends ⅛-inch past the center." Mr. Campbell made a motion that these recommendations be accepted. The motion was carried.

The secretary read a correction to Rule 58 as follows: "When cars are found to be equipped with other than M. C. B. standard 1⅜-inch air hose, owner is responsible. Any railway finding a car on its lines equipped with hose not M. C. B. standard may apply such standard hose and bill owner. For any hose applied, name of maker, date of manufacture and size must be shown on the M. C. B. repair card." This was accepted.

Chairman Boutet recommended that Rule 98 should call for a report of price of cast steel wheels and steel tired wheels. This was put to vote and accepted.

Mr. Schultz moved that reference to tank cars in Rule 2 be eliminated. This was unanimously accepted.

Mr. Schultz then read the following resolution, moving its adoption:

"Whereas, the Master Car Builders' code of interchange represents a signed and binding contract entered into by the executive officers, for and on behalf of the railroads of this country; and

"Whereas, the practice of applying M. C. B. defect cards at time of interchange in accordance with M. C. B. rules is entirely practicable; and

"Whereas, word has been received that the American Association of Railroad Superintendents has undertaken to restore M. C. B. rules, working in conjunction with the M. C. B. Association and the Association of Transportation and Car Accounting Officers; therefore,

"Resolved, That the executive committee of the Chief Interchange Car Inspectors' and Car Foremen's Association most heartily endorses this move and pledges its utmost support to the end that the M. C. B. code shall be enforced at all interchange points; and be it further

"Resolved, That a copy of this resolution be sent to each member of the Chief Interchange Car Inspectors' and Car Foremen's Association that their hearty co-operation with mechanical and transportation officers may be secured in bringing about this much needed reform, effective if possible on April 1st, 1912, the date the practice is adopted in Chicago and other important interchange centers."

The resolution was adopted.

Recommended Changes in M. C. B. Rules.

Rule 2.

Eliminate all that portion in the fifth paragraph of Rule 2 pertaining to leaking tank cars. Add another paragraph after the fifth paragraph to read as follows: "No transfer order is to be given for any car that the repairs can be made with the load in the car inside of twenty-four hours, as shown in M. C. B. Rule No. 107."

Rule 32.

Change Sec. 2 of Rule 32 so that the last paragraph will read as follows: "Defect cards shall not be required for any damage so slight that no repairs are necessary." For example, edge of roof, end facia, side facia, end and side moulding, end and side door cap, end and side sheeting, side and end doors, side posts, side braces, door and corner posts, side and end stakes, side and end planks, ends of flooring (coal, flat and stock cars) all sills, draft timbers, cross ties, deadwood, sub sills, body bolsters and all siding if not damaged sufficient to impair the strength of these parts.

Rule 33.

Add to Rule 33, after the word "end doors" and parts, queen posts, truck springs, stakes pockets on coal cars, release rods, top side bearings when not riveted to transoms, refrigerator hatch covers, door guides, door slide, castings, buffer castings. This to end the rule.

Rule 42.

Cut out combination Rule 42.

Rule 43.

After the word "corrosion" in Rule 43 eliminate the rest of the paragraph and insert the words "not damaged sufficiently to impair the strength or necessitate removing."

Rule 56.

Eliminate Rule 56.

Rule 58.

Eliminate Rule 58.

Rule 64.

Add to Rule 64 brake shoes and keys, pedestal castings, side bearings when not riveted. Add another paragraph to the rule as follows: Any slight damage to trucks that does not impair the strength of the parts damaged or require immediate repairs.

Rule 69.

In Rule 69, after the word "78" take out "chipped flange, if chip is on the throat side of flange."

Rule 82.

Change Rule 82, "Chipped flange; if chip exceeds 1½ inches in length, one-half inch in width and extends ⅛ of an inch past center."

Rule 98.

Add to Rule 98 showing the price of cast steel wheels and steel tired wheels.

Rule 17.

Another section of Rule 17 as follows: When cars are found to be equipped with other than M. C. B. standard 1⅜ in. air hose, owners responsible. Any railway company finding a car upon its line equipped with hose not M. C. B. standard may apply M. C. B. standard hose and bill owners. For any air hose applied name and maker, date of manufacture and size must be shown on M. C. B. repair-card.

Recent Railway Mechanical Patents

SPRING.

1,013,774—William S. Hodges, of Philadelphia, Pa., assignor, by Mesne assignments, to the Baldwin Locomotive Works, Philadelphia.

The construction of this new spring end and clip for locomotive side frames will be apparent from the illustration. The clip has a rib *c* which fits into the groove a3 and this holds the parts in position.

CAR-TRUCK.

1,014,362—John C. Barber, Chicago, Ill., assignor to Standard Car Truck Co., Chicago, Ill.

In this form of the well known Barber truck the lateral motion bearings and the radial motion side bearings are placed directly one above the other under the main side sill of the car. Also the roller side bearing is placed below the compression member of the truck frame.

ADJUSTABLE BRAKE-HEAD.

1,013,311—Edward D. Pugh, Cleveland, O., assignor to the Damascus Brake Beam Co., Cleveland, O.

This invention relates to a head or brake-shoe carrier for railway brakes, of that class in which provision is made for changing the angular position of the brake head relatively to the brake-beam, in order that the concave face of the brake-shoe may conform to the periphery of the wheel at different heights at which the brake-beam may be hung. In brake-beams of this type, it is desirable to have the brake head so mounted upon the brake beam that it can be angularly shifted in pressing against the wheel, so as to determine the exact position which it should assume in use, and then fixed at the angular adjustment thus determined so that, when in use, the brake head will not shift angularly or vibrate.

The object of the invention is attained by providing the end of the brake-beam and the socket of the brake head, which fits the sleeve, with inter-engaging teeth arranged in segmental series upon the cylindrical surfaces of the sleeve and socket, and sufficient in number to provide for the range of angular adjustment, which is found in practice to be desirable. These teeth extend in the direction of the axis of the sleeve and socket, but the short distance necessary to resist the slight turning tendency of the brake head on the beam; a portion of the sleeve and socket being left, sufficient to permit the brake head being placed on the brake-beam and applied to the wheel to determine its angular position before it is pressed to its seat with the teeth in engagement to maintain the adjustment thus determined; suitable means being provided to hold the brake head on the brake-beam after the parts are angularly interlocked. The interlocking parts may be duplicated to avoid multiplication of the members for different ends of the brake-beam, and the securing device may be so disposed as to serve when the brake head is reversed.

LOCOMOTIVE.

1,013,771—George R. Henderson, Philadelphia, Pa., assignor, by Mesne assignments, to the Baldwin Locomotive Works, Philadelphia, Pa.

This invention relates to certain improvements in compound locomotives, especially of the type in which the locomotive boiler extends over two frames, which are coupled together by an articulated joint. In this type of locomotive the usual practice has been to use an ordinary tender and these locomotives are now of such size that the tender must be of an appropriate size and, consequently, must be heavier than those heretofore used.

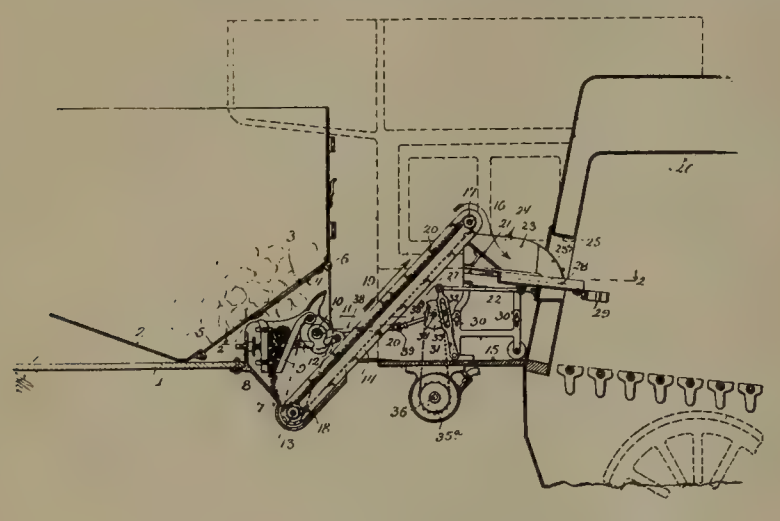
One object of the invention is to utilize a large portion, or all, of the weight of the tender for purposes of adhesion and traction, as well as the weight of the locomotive proper. This is attained by mounting the tender on a driven element corresponding in many parts to the two elements on which the locomotive boiler is mounted so that, in the present instance, there are three independent driving units to form a triple, compound locomotive.

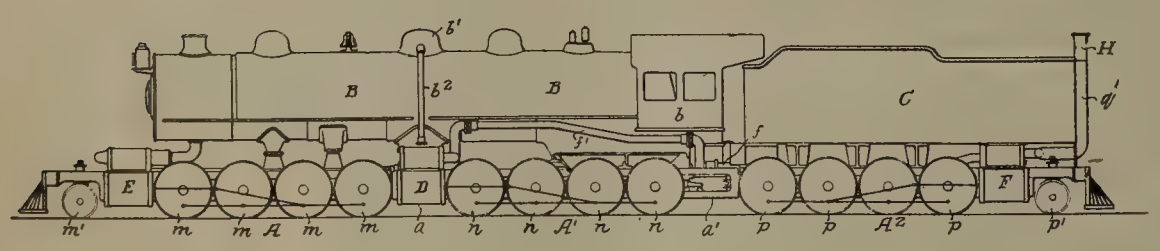
AUTOMATIC STOKER FOR LOCOMOTIVES.

1,017,682—Alexander J. McMullen, Milwaukee, Wis.

A locomotive having a furnace provided with a feed opening and a detachable coal-tender has a stoker in communication with the furnace feed opening and a forwardly and downwardly inclined bottom section for the tender, together with a forwardly and upwardly inclined bottom section in hinge connection with the first named bottom section. The upwardly inclined bottom section is provided with a door controlled feed opening, a coal crusher detachably secured to the tender under the inclined bottom section and in register with its feed opening, an endless coal feeding conveyer apron yieldably connecting the crusher and stoker, a motor carried by the locomotive, an endless belt drive gear connection between the motor and stoker, and a tumbler-rod in gear connection with the stoker and crusher, whereby the same is driven.

1,013,771.





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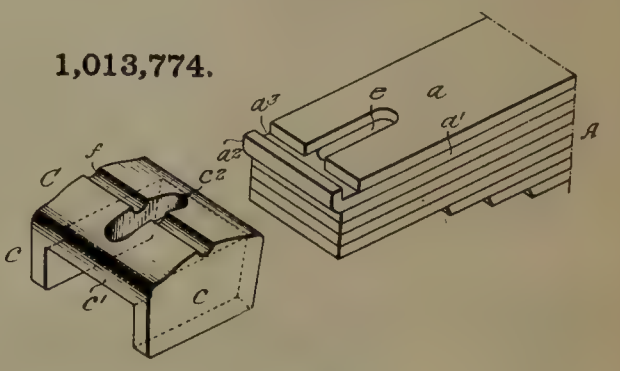

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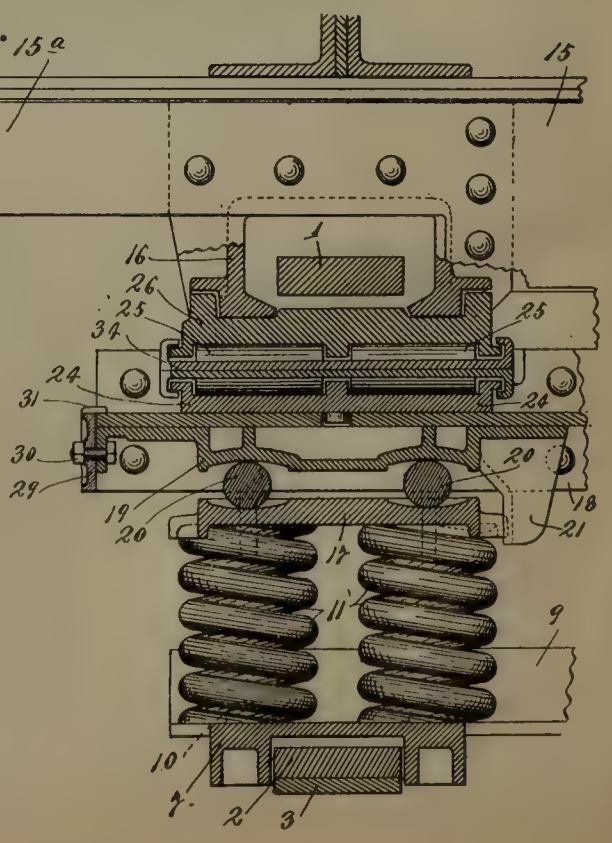
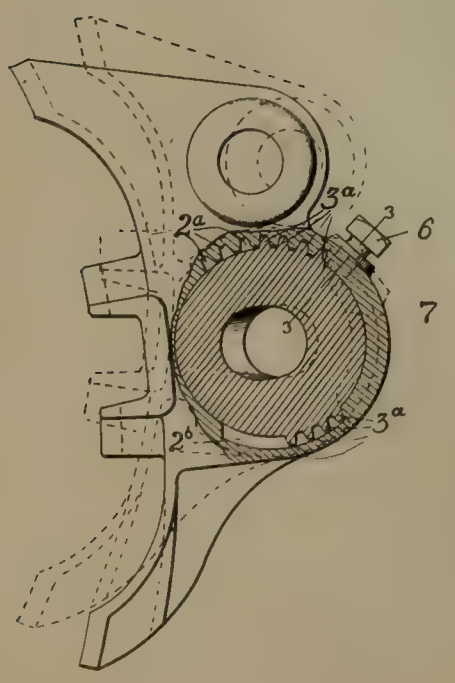
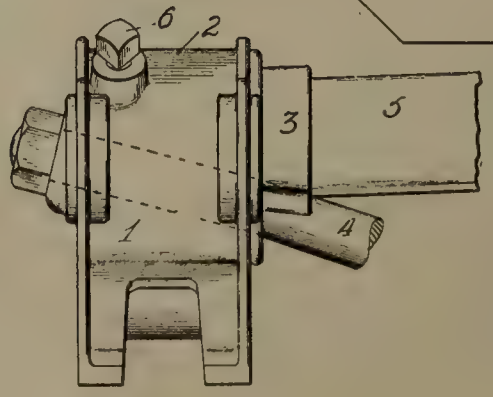


1,013,311.





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FORGED STEEL WHEELS.

On page 94 of the March issue we published an abstract from a paper on Forged Steel Wheels, read by C. G. Bacon, assistant to the president of the Forged Steel Wheel Co., before the Western Railway Club. In this paper Mr. Bacon was most emphatic in his recommendations for a standard rim thickness, for forged steel wheels, of 2½ inches and for a hub wall thickness of 1¼ inches at the smallest diameter.

With respect to the question of hub wall thickness, little criticism of Mr. Bacon's stand was made, the question of rim thickness, however, called forth opinions at variance with those expressed by the writer of the paper. With respect to this point Robert Radford spoke as follows:

> "Regarding the thickness of the rim, I am sorry that I cannot agree with Mr. Bacon that in the rolled steel wheel the 3-inch thick rim is not as efficient and economical as regards the service obtained as the 2½-inch. I readily admit that the rim can be made too thick and that three inches should be the maximum in order that the steel may be thoroughly worked. This is the advantage of the rolling process. If the 3-inch rim is thoroughly worked and homogeneous throughout, I cannot follow Mr. Bacon's remarks that you do not get the one-half inch additional wear from the 3-inch thick rim, as the limit of wear groove is the same distance from the inside diameter of the rim on either thickness. Of course, if the additional one-half inch thickness of the wheel is added to the inside diameter, I can appreciate the 3-inch thick rim will not wear as favorably per sixteenth inch of diameter, as the smaller the diameter the more rapid the wear, but if, on the other hand, as I have stated previously regarding the steel tired wheels, the additonal one-half inch is added to the outside diameter, the mileage per sixteenth inch of wear should show as favorably on the 3-inch as the 2½-inch."

This seemed the sentiment of the majority present and was covered in a slightly different manner by L. F. Wilson, editor of the *Railway Master Mechanic,* as follows:

> "With reference to his recommendations for a two and one-half inch rim thickness, I cannot believe that all in this room are satisfied with his explanation and reasons for such a limitation. His statement to the effect that the addition of half an inch of rim thickness makes all the difference between a good and poor wheel, deserves a more complete diagnosis.
>
> "I am not in a position to say that the three-inch rimmed wheel is a better wheel. It would be presumption for me to do so, but I think that few motive power and car men would be willing to accept the loss in wheel mileage which goes with the thinner rim, until a better reason for so doing is forthcoming than that given by Mr. Bacon here tonight.
>
> "As a manufacturer's representative, Mr. Ba-

con's statement that a railway cannot know what it is getting in a steel wheel with a three-inch rim, owing entirely to the extra half inch of thickness, must carry weight. But if we are to accept it, we are not going to be dubious about the two and one-half inches as well. It would seem that if this were the case, one cannot know what he is getting in the metal of the hub, which is of considerably greater thickness. Of course, I know that the demands of service on the rim and on the hub are quite different.

"The railways want to get as much mileage out of the solid steel wheel, or out of any other wheel, as it is possible to obtain, and it would seem that a more satisfactory answer to this question is to be demanded. An inch and a half of material for wear and machining is not as good a proposition as is two inches usable in the same way."

In both of these discussions the points made are conditional. If we are to take Mr. Bacon's word, given in his closing statement, a rim of homogeneous metal three inches thick is impossible in modern manufacturing practice. After carefully considering the replies from a large number of mechanical officials, to our request for information as to their opinions, we publish the following letter from Mr. Brazier as indicative of the position of most of those interested:

Editor Railway Master Mechanic: I have your favor of the 21st in which you ask my preference in the matter of rim thickness for solid steel wheels. We have quite a number of wheels in service with 2½-inch rims. Personally, I can see no harm in having rims three inches thick, and unless there is something in the construction of the wheel that would be a detriment, I am in favor of the three-inch rim thickness for solid steel wheels.

F. W. Brazier,
Supt. Rolling Stock,
New York Central Lines.

The wheel committee of the Master Car Builders' Association is now considering this subject. In view of recent events, its report next June will be awaited with interest.

RELATION OF CONDITION OF EQUIPMENT TO ACCIDENTS.

Certain so-called "yellow" newspapers in New York and Chicago have been conducting a campaign against the New York Central Lines which for malicious misrepresentation is without precedent. The difficulties with which all railways have been contending in operating under the adverse conditions of a severe winter have been made to appear peculiar to the New York Central. A paragraph is given in nearly every issue of these papers showing the schedule of arrival of the fast trains of the system, attempting to convey the impression to the public that New York Central trains have been the only ones which have been running behind time to an unusual extent.

Among the institutions of modern civilization nothing is more dangerous than the dishonestly edited, ignorantly written articles of this nature published in newspapers of more or less wide circulation. Needless to say the journals in question are used and manipulated in cases of this kind as a means of getting back at the objects of wrath in instances of distinctly personal animosity on the part of the owner.

A wreck on the New York Central furnishes news which, after having been garbled in the most approved fashion of modern yellow journalism, beautifully serves the purposes desired. While headlines referring to rusty rails, soft ties and lax inspection bring nothing more than contemptuous smiles from those who know enough of railway operation to see the inconsistencies, the desired result as far as the general public is concerned is satisfactory to the instigator of this contemptible campaign.

These shafts are directed at a railway system which, for high standard of equipment and operation, has long more nearly approached the technical man's ideal than has that of any other. If there was any truth in the attacks the country would be in a bad way indeed with respect to its transportation lines. In so far as the cub reporters have gone in attempting to show that defective equipment has been used, nothing has been developed other than malicious falsehood and glaring inconsistency. This brings us, however, to consideration of the present situation with respect to railway equipment in general.

The frequency with which railway accidents of serious nature are occurring cannot but alarm those who have been watching the reports. Collisions have been in the minority, by far the larger number of the accidents that have been due to derailments and can be directly attributed to failures in equipment. The summer season will record a lesser number of accidents than have occurred in the months past. Cold weather is a factor tending to the disruption of railway traffic in many ways. We can, however, look forward to another series of serious accidents which will be terrifying to the public, with the beginning of cold weather in the fall of 1912.

Regulatory legislation is directly to be blamed for this condition. So expensive has it been to comply with the exactions of law made in the last four years by state and national legislative bodies, that the railways have been compelled to spend money, which otherwise could and would be used in the improvement of equipment, in carrying out the letter of these laws. Railway operation has been made so much more expensive within the last four years, that double the appropriations of four years ago would be necessary to maintain the equipment in average condition and at the same time comply with these laws. These larger appropriations have not been made; they have, indeed, been cut in most instances, and for good reasons. Absolute inability to make these appropriations, is the customary defense. Whether or not this defense will stand, is a question for the close student of high finance. The fact remains, they have not been made.

Were the ordinary thinking man to be confronted with the inside facts as to conditions as they really are, he would be at once amazed and alarmed. 60-mile-an-hour trains cannot be operated safely with 30-mile-an-hour equipment. Loco-

motives which should have received general heavy repairs a year ago will cause failures and accidents when continued in operation at the heads of fast trains. Tracks which should have been relaid and ballasted a year ago will not stand heavy fast traffic without danger of serious accident. We repeat that the condition of track and rolling stock the country over is such that were the millions, now being diverted to ineffective applications by regulatory legislation, appropriated at once for the proper channels, it would take several years to restore conditions to the normal.

This then is a situation the people of the United States must face at once. Service must be cut, schedules must be slowed down and economy must be practised in a different field. Whereas, heretofore retrenchment has meant reduction in the repair and purchase bills on ordinary equipment; future retrenchment must mean reduction of cost of haulage per passenger mile. This can be done in several ways, each of which means the elimination of what may be termed luxuries in travel. Rates have been determined by legislation. The necessary expenditures for the maintenance and purchase of equipment are fast being proved to have been too small for the last four years. Still net earnings are in a great many instances minus quantities and always too small to pay a proper conservative interest on investment.

MACHINE TOOLS AND PASSAGE-WAYS.

In planning the location of machine tools in a shop, attention is given to the routing of materials, that is, that machines be so placed that work may travel the least distance during its progress to the various machines. Occasionally business doctors are called in at a heavy expense to improve the efficiency of shops, and this often results in changing the locations of a number of machines. However well the machine tool layout may have been devised when the shop was new, its efficiency will necessarily be decreased after the course of a few years. The necessity for larger storage room for castings may decrease the size of a passage-way, or may blockade a door; a stairway may, on account of placing new machine near it, hinder materials from passing around it. Conditions are constantly changing and the average shop superintendent should be able to make beneficial changes, if he will take the time to note conditions, as well as do the efficiency men. If so much material passes down an aisle that there is congestion and occasionally a blockade, something is wrong with the routing of material and the location of some of the machine tools. Possibly a new passage-way can be opened and some of the work can take a different course. It is difficult to keep passage-ways clear, especially the main one through the center of the shop, for on occasions it is almost impossible not to encroach on this space, particularly if it is not marked. Some shops have marked aisles by painting a white strip on either side, thus outlining them, which is a very good thing if a rule against encroaching on them is strictly enforced.

Roofed-over floor space is worth money; it should be drawing a reasonable interest on the investment. How often though, you will see a number of machines so placed that a pocket is formed where it is difficult to get material in or out and which becomes a place for dumping and storing rubbish. Here good floor space is wasted, bringing absolutely no return. Perhaps a counter-shaft has been placed on the floor and a horizontal belt is used to transmit power to the machine. Such a case is probably not frequent, especially in these days of individual drive, but it illustrates how free movement may be hindered and good floor space rendered useless. The growing use of individual motor drive, however, is going to make it much easier to move a machine if it becomes necessary, because there will be no necessity to consider the line shaft. We do not advocate that extreme refinement where the energy and time spent in so doing overtops the practical benefits which may result but we do say that if the men in charge of our shops would take a day or so, say every six months, to go through the plant with the sole view of looking about for places where space was being wasted, where aisles were congested and where, apparently, there was poor relation of machines, that the result would be perhaps as good as turning in a flock of efficiency engineers and certainly much cheaper.

U. S. MAIL.

The efforts of the present administration to make a showing of economy in the post office department have, as is only too well known to those who have any occasion to use the mails, resulted in chaotic conditions. To those whose business depends upon efficient mail service the present demoralization of the department is most serious.

Some months ago an arrangement was made to carry the monthly magazines in freight service instead of on passenger and mail trains as heretofore. It was expected that this would result in better and cheaper first class mail service. Complaints from all parts of the country seem to indicate that the opposite has been the case. The reason for this situation has been said to rest upon the fact that on account of a lightening of the mails, certain special mail trains have been taken off, thus throwing letter mail into slower passenger service.

Whatever the reasons, the fact is that the subscribers to the monthly papers are getting them, if at all, on a "go as you please" or haphazard schedule. It does not seem that this system of false economy can continue through another period of administration. The following, taken from the daily press, outlines the conditions in a very emphatic manner:

> Overworked men in every department, stacks of mail in the cellars of the post offices that should have been dispatched days ago and deliveries that are hours, sometimes days, behind schedule, are conditions said to be due to the desire of Postmaster General Hitchcock to make a reputation and a record for economy.

The collection and delivery system in Chicago and elsewhere throughout the country, it is said by post office employes, is a by-word. Business interests are severely hampered and injured by conditions that easily could be improved.

There is no longer any esprit de corps among the men. The misuse of the civil service system for the exaltation of favorites and politicians has killed all that. Postmaster General Hitchcock, too, has been the means of instituting a so-called demerit system by which men are marked like schoolboys for trivial mistakes. The man who gets the demerit has to pay fines to the government and when a man gets only thirty marks out of a hundred, or seventy demerits in a month, the postmaster is forced to recommend his removal. That system has been shamefully abused.

Post office employes are all disgusted with the economical policy of the postmaster general, and it will cost the administration thousands of votes through the country. If business men knew how lax matters are and how their interests are affected and threatened, they would open the eyes of the government to the utter folly of the present system.

A business man who recently had a complaint against the nondelivery of some important mail and who was intimately acquainted with some post office officials made a tour of the cellars underneath the Chicago post office and stumbled over thirty sacks of mail that had been lying in a corner more than two weeks.

ACCIDENT STATISTICS, covering 57 per cent of American railway employes for a period of three years, show that the number killed varies inversely with the wage earned. Employes are arranged in five groups, those in group A earning $125 a month or more, while those in group E earn $50 a month or less. Of group A 417 were killed, while in group E 1,886 were killed. It is interesting to note, however, that the total amount paid as compensation in each of the five classes is practically the same, being slightly higher for those receiving the highest wage.

* * *

LOAN SHARK VICTIMS among the employes of the Illinois Central are to receive aid and advice from the educational bureau. There has been a great deal of agitation in Chicago recently against loan sharks and their methods and it is probable that this move was due in a measure to this agitation. The plan is not perfected as yet, but in the general circular, employes who are in trouble are invited to present their cases to the educational bureau in order that it may know what employes need and what it can provide in the way of aid. The rules as regard garnisheeing have not been rescinded, but the bureau is to respect all confidences. The Rock Island has also offered to give legal aid to its employes who are in the clutches of loan sharks. This move on the part of the Illinois Central and Rock Island is very commendable. It is an instance of the many ways in which railroads are insuring an efficient and loyal organization.

* * *

A CAR WEIGHING INQUIRY is the next thing that the railroads are to face, such an inquiry having been begun by the Interstate Commerce Commission during the latter part of March. The complaint was made by a number of lumbermen's and coal dealers' associations that in general railroad scales are inaccurate and that the weighing is done in a haphazard fashion by irresponsible men. Probably if given time we shall have government weighmasters on all of our roads.

* * *

THE INTERSTATE COMMERCE COMMISSION handed down a ruling on March 24 establishing the principle that a railroad must adjust its rates on interstate traffic so that no injustice will be done between towns regardless of state lines. The case in point was on the St. Louis & Southwestern, which operates in Louisiana and Texas. The Texas commission had ordered certain rates between Dallas and other points in Texas which were lower than those between Dallas and Shreveport, La. It was claimed that this was unfair discrimination by the Louisiana commission and its contention was upheld by a 4 to 3 vote of the Interstate Commerce Commission. The minority held that the majority opinion was an usurpation of the powers of Congress. The decision, however, fixes all the more strongly the supremacy of the national commission, for it was held that the tolerance of such a condition as above mentioned would be to admit that a state could limit and prescribe the flow of commerce between states. The powers of the Interstate Commerce Commission with regard to interstate commerce were again affirmed in a decision handed down by the Supreme Court on April 1 in the case of the Goodrich Transit Co. The Commission had sought to compel the Goodrich people to make reports covering traffic within states as well as interstate traffic. The Commerce court held that the Commission could not compel the filing of intrastate reports but the decision of the Supreme Court recognizes this right and reverses the decision of the Commerce Court, thereby giving the Commission more authority over the entire carrying facilities of the country.

* * *

THE LOCOMOTIVE ENGINEERS on fifty railroads east of Chicago and north of the Norfolk & Western Railway on January 22, 1912, presented requests for wage increases amounting to 18.63 per cent per annum. A committee of general managers and vice-presidents was appointed to represent the railroads in the territory named, and on March 14, in New York, the conference committee of managers met a committee representing the engineers, for whom W. S. Stone, grand chief engineer of the Brotherhood of Locomotive Engineers, appeared as spokesman. On March 14 and 15 Mr. Stone presented the case of the engineers, saying in effect that the wage increases asked by the engineers were sought, not because of the increased cost of living, but because of what he termed the increased responsibility placed on the men.

Following Mr. Stone's exposition of the case, an adjournment was taken until March 25, at which time the formal reply of the railroads was given to the engineers.

Realizing the great public interest in any wage controversy involving the railroads in the eastern section of the country, and feeling keenly their duty to the public as carriers, and also their obligations to their stockholders, the managers wish to announce that full and complete information will be given by the railroads as the negotiations progress. The managers feel that with all the facts in the present controversy fully understood by the press and the public, the prospects of a settlement fair to the interests immediately concerned as well as to the public will be improved.

In view of the above, the managers will give out any information available, and inquiries made of the committee at Room 580, 50 Church Street, New York City, will meet with prompt reply.

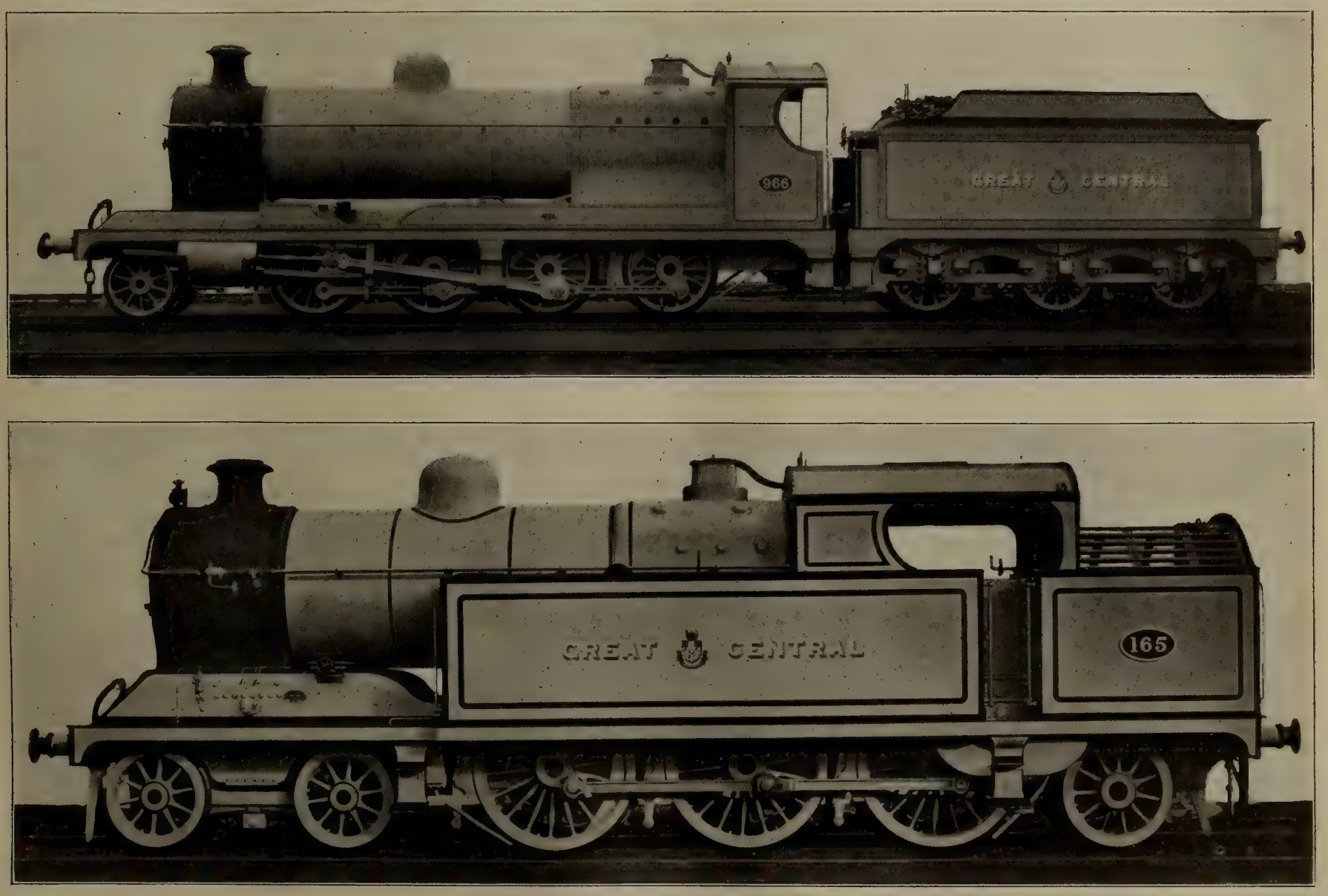
British Locomotives in 1911

By. Thos. Reece.

While depression has been the note of the locomotive building industry in the United Kingdom in 1911 owing to the restricted demand for the machines, things were better than in 1910 and the number of men employed in thirteen of the leading Scottish works, for example, rose on the year from 20,274 to 22,503. These figures, however, still show a tremendous fall from the 1907 figures of 24,450. At the same time in other respects the year has been remarkable in the railway history of the country. Forward strides have been made in the adoption of superheating which now appears to have quite passed the experimental stage for several railways.

With regard to the new and interesting locomotives of the year advantage might be taken of an interesting article in a Manchester paper to summarize some of these for readers of "Railway Master Mechanic." Starting with the Great Western, this line appears to have dropped the continual multiplication of new types of locomotives—a change which became noticeable after the building of the large "Pacific" type of engine "The Great Bear" two or three years ago. Latterly Mr. Churchward has rather multiplied the number of engines of his most successful types, especially of the 4-6-0 type, and he has been rebuilding some of the earlier 4-4-0 type and bringing them up to date. He has, however, built 20 engines of a mixed traffic 2-6-0 wheel arrangement. The employment of the superheater on this line has become common, and a special type has been developed known as the "Swindon" superheater.

On the London and South-Western the complete removal of the locomotive works from Nine Elms to Eastleigh has brought about considerable activity in engine building, and Mr. Drummond has signalized this by building some more of the heavy and very powerful six-coupled 4-6-0 express engines with four cylinders, the first of which type was brought out in 1906. These new engines, which are primarily designed for the Bournemouth express traffic, are slightly different from the earlier ones. They have coupled wheels 6 ft. 7 in. diameter instead of 6 ft., and the four cylinders are placed in line below the smoke-box, those inside actuating the leading coupled axle, whilst the outside pair drive the middle pair of coupled wheels. The cylinders are 15 in. by 26 in., and piston valves are used with the Walschaert valve gear. The bogie wheels are 3 ft. 7 in. diameter, the steam pressure 175 pounds per square inch, and the total heating surface 1,920 square feet. The Drummond water-tube fire-box is fitted, and the safety valves are over the fire-box instead of on top of the dome. The engines weigh in working order 68½ English tons each and the eight-wheeled tenders 40 tons (89,600 pounds).



Locomotives of Great Central (England), Standard Types.

On the London and North-Western railway there has been considerable activity, especially in express passenger locomotive building. The three-cylindered passenger compounds may now be said to be obsolete, and the four-cylindered are now practically restricted to ordinary or fast passenger traffic, the chief exception being some of the Manchester-to-Liverpool express trains. The express work generally is now being done by Mr. Whale's "Precursor" (4-4-0) and "Experiment" (4-6-0) classes, and the new engines of a similar type built by his successor, Mr. Bowen-Cooke.

It may be remembered that the "widened" type of passenger rolling stock has been generally adopted by the leading lines

in this country since it was proved so successful for suburban traffic some years ago on the Great Eastern by James Holden, at that time the chief mechanical engineer of that railway. This widened stock is naturally considerably heavier than the older types, and powerful though Mr. Whale's engines are, the continually increasing weight of express trains and their high speeds made it necessary for Mr. Bowen-Cooke to look still further ahead. Accordingly, having dropped the compound system for the London and North-Western, he determined to try superheating, and in July, 1910, a "Precursor" type of engine of slightly heavier build was constructed and named "George the Fifth." An extended trial of this engine against another of the same type but non-superheated proved so satisfactory that during the first ten months of 1911 a continual procession of these locomotives may be said to have come out of Crewe works. The company now owns some fifty of them, and all but about five have been built in 1911. So quickly have these engines been put to work that most of them are still running in the rough lead color which is usually painted over when an engine has done its trial trips.

One of these engines, "Coronation," has attracted much public attention, as it figured largely in the royal journeys at the coronation, and especially at the Prince of Wales' Investiture journey to Carnarvon. The engine, moreover, is notable as the 5,000th turned out of Crewe works, and to mark this it was painted in special colors; a good deal of gilding is used in picking out the panelling, a brass crown surmounts the nameplate, and wheel bosses and buffer-ends are bright steel. The dimensions of this and the other engines of the "George the Fifth" class are as follows: Cylinders, 20½ in. by 26 in.; boiler, 5 ft. 2 in. diameter, length of barrel 11 ft. 9¾ in.; heating surface, 1,849.65 sq. ft.; grate area, 22.4 sq. ft.; firebox, 7 ft. 4 in. long and 4 ft. 1 in. wide outside the casing. The working steam pressure is 175 pounds per square inch, and the temperature of the steam in the superheater is up to 650 degs. Fahr., or, say, 270 degrees of superheat. The valves are 8 in. pistons working by Joy's valve gear. The driving-wheels are 6 ft. 9 in. diameter, bogie-wheels 3 ft. 3 in. diameter, the coupling rods 10 ft. center to center, and the Webb type of central balance weight is employed. The engine in working order weighs 134,064 pounds, and the tender with 15,680 pounds of coal and 3,000 gallons of water 87,920 pounds.

The first few days of 1911 saw the appearance also of Mr. Cooke's new type of passenger tank engine, which resembles largely the "Experiment" passenger engines, just as Mr. Whale's large tank engines were practically of the "Precursor" class. It was rumored that Mr. Cooke's new tanks were to have been of the 2-6-4 type—that is, six-coupled, with a leading pair of "pony" wheels and a trailing bogie under the bunker, a novelty for Great Britain. Whether this type was contemplated at first it is hard to say, but what has been built is a six-coupled engine with a leading bogie and trailing pair of wheels of the 4-6-2 type. The dimensions are: Bogie-wheels and trailing-wheels, 3 ft. 3 in. diameter; six-coupled wheels, 5 ft. 8½ in. diameter, the total wheel base being 33 ft. 9 in. The boiler has a working pressure of 175 pounds per square inch and a total heating surface of 1,475 square feet. The cylinders are 18½ in. by 26 in., whilst the tanks have a capacity of 1,700 gallons of water and the bunker three tons (6,720 pounds) of coal. The total weight of this engine in working order is 174,720 pounds. A number of this class have been built, some of which have superheating and one or two have feed-water heating apparatus. They have also the water pick-up apparatus so arranged that it can be used both when running forward or backward, and this, oddly enough, is a novelty on London and North-Western tank engines, though the Lancashire and Yorkshire have had it for many years, and the water-scoop for ordinary passenger engines was a London and North-Western patent and first used in 1859. These tank engines have also Belpaire fire-boxes, another innovation on this line, only two having been previously fitted on a couple of the Webb four-cylindered "Diamond Jubilee" compound class.

In November Mr. Bowen-Cooke turned out the first of a new superheated class of "Experiment" type of six-coupled 4-6-0 engines named "Prince of Wales." The original engine of this name was a 7 ft. 6 in. single Ramsbottom engine, which was involved in the terrible accident near Abergele in August, 1868, and, being repaired at the time and later rebuilt with a new boiler, ran till 1906, when it was scrapped by Mr. Whale. Ten of this new "Prince of Wales" class are already running, still in lead color, and more will be built. Like the "George the Fifth" class, they have slightly larger cylinders and are fitted with a mechanical lubricator. Mr. Bowen-Cooke is also still converting the 0-8-0 Webb compound mineral engines to two-cylinder simple engines, practically all the three-cylindered engines having been so dealt with, and a number of the four-cylindered, and he is also building more new engines of the simple 0-8-0 class. Another feature is the number of the small 2-4-2 Webb tank engines which are being refitted for "motor" train service, being now too small for main line work.

The North-Eastern railway have had some very powerful "Atlantic" (4-4-2) express engines built, and, contrary to their custom, by outside makers. They are simple engines, but with three cylinders all in one caseing, and half the number use ordinary saturated steam and the other half are superheated. The former have cylinders 15½ in. diameter by 26 in., and boiler pressure of 180 pounds per square inch; whilst the latter have cylinders 16½ in. diameter by 26 in., and 160 pounds pressure. The boiler is 15 ft. 10½ in. long and 5 ft. 6 in. diameter, with a heating surface of 2,340 square feet. The bogie wheels are 3 ft. 7¼ in. in diameter, the coupled wheels 6 ft. 10 in., and the trailing wheels 4 ft. The engines weigh in working order 172,480 pounds and the tender 100,800 pounds.

The Great Northern have built some ordinary six-coupled goods engines of a previous powerful type but with a superheater, and also some 4-4-0 passenger engines with the same boiler as the goods and also having the superheater.

The Great Eastern, after rebuilding their 4-4-0 express engines with larger boilers, and also some new engines of the same type, are bringing out a new class of 4-6-0 engines.

On the Midland the policy of rebuilding the later Johnson engines is still being pursued, and experiments are being made with superheating both with the Schmidt and the "Swindon" types.

On the Great Central Mr. Robinson has built some new eight-coupled mineral engines with a leading "pony" pair of wheels, thus making the 2-8-0 type, an unusual one in this country. The cylinders are 21 in. by 26 in., the coupled wheels 4 ft. 8 in. diameter, the working pressure 160 pounds per square inch, whilst the boilers have a heating surface of 1,538 square feet. The engines weigh in working order 162,400 pounds and the tenders 103,376 pounds. The boiler is fitted with a smoke-tube superheater of 18 elements, the pipes of which are expanded direct into the header, which occupies its usual position across the smoke-box and above the tubes, so as to leave the latter unobstructed for cleaning. This is now the accepted design of superheater on the Great Central Railway. There are 18 large tubes 5¼ in. outside diameter containing superheater elements, each of which consists of four lengths of 1 3-16-in. bore solid drawn steel pipe in series, the return bends being made solid and thickened up on Howell's "Torpedo" system. The cylinders are fitted with Robinson's patent pressure release valves, which automatically open both ends of the cylinders to the atmosphere when steam is shut off and automatically open when steam is on if the pressure in the cylinders should rise above that in the steam-chest, as might happen if water were present. These valves, therefore, fulfill three functions:

(1) They perform the work of the steam-chest air valves by preventing the formation of a vacuum when running without steam.

(2) By preventing compression at the end of the piston stroke when running without steam they overcome the "knock" on the connecting-rod bearings caused thereby, thus doing the work of the by-pass ports and cock often fitted to piston valve engines for this purpose.

(3) They are most effective priming valves, opening when the cylinder pressure is only a little above that in the steam-chest, no matter what the latter may be. In this way they replace the usual spring relief valves, which do not open until the cylinder pressure has risen to something above the working pressure of the boiler.

All parts of the engine have been designed to duplicate as far as possible with those of existing types. The boiler is the same as that used for the "Atlantic" engine, the cylinders will interchange with the "Atlantic" 4-6-0 and 0-8-0 engines, and the coupled wheels, axles, motion, etc., are those of the existing 0-8-0 class. The leading truck is of the swing-link type, having a cross-travel of 6 in. which in conjunction with thin flanges on the intermediate and driving wheels enables the engine to pass five chain curves with ease.

Locomotives of North Eastern (England), Standard Types.

Six new "Atlantic" type locomotives have been built for the London, Brighton and South Coast Railway similar to the original batch of 1906 but here again with the superheater and with cylinders of 21 in. diameter.

On the Lancashire and Yorkshire a new class of eight-coupled 0-8-0 mineral engines has been put into service. They have two inside cylinders 20 in. by 26 in. and coupled wheels 4 ft. 6 in. diameter. The boiler is similar to that fitted to the 4-6-0 express engines and has a heating surface of 2,455 square feet and a steam pressure of 180 lb. per square inch, and the engine has a total weight of 149,632 lbs. The tenders are large for this line, as they have eight wheels and weigh 92,960 lbs. It is notable that these engines have been built since the Hughes' compounds, which latter he built after the other English railways had given up the system. The Glasgow and South-Western have built a new 4-6-0 express engine similar to those of their other classes, but fitted with a superheater and larger cylinders. The North British Railway have again, after some years, reverted to the "Atlantic" type, and have had six of these heavy engines built. They have two cylinders 20 in. by 28 in., driving wheels 6 ft. 9 in. diameter, and the total weight of the engine is 167,440 lbs. and the tender 103,600 pounds. Two engines on this line have been running with the Phoenix superheater, whilst four are being equipped and two new ones built with the "Schmidt" type. The Caledonian Railway has seven engines superheated, two more are being fitted, and four new engines are being built with superheating apparatus. It has been found already that engines on this line with steam pressure of 180 pounds and 200 pounds per square inch can be reduced to 160 pounds and 165 pounds respectively and cylinders of 19 inch diameter increased to 20 inch and 21 inch. The Highland Railway also has a locomotive fitted with the "Phoenix" superheater and the Great North of Scotland Railway is making a trial. The Furness Railway has also tried five engines with the Phoenix superheater. The Great Northern of Ireland Railway has some new 4-4-0 express engines with cylinders 18 in. by 24 in. and a heating surface of 1,459.5 square feet including the superheater surface with which these engines are also fitted. The engines weigh 104,160 lbs. total. Some powerful 0-6-0 goods engines have been built also with superheaters, cylinders 18 in. by 26 in., and 1,672 square feet of heating surface. The concluding example is a 4-4-2 superheated tank engine on the North Stafford Railway. It will thus be evident that while compounding has been tried and found wanting in the United Kingdom superheating is likely to become general.

As regards passenger rolling-stock, the building of the heavy "Widened" stock, corridor and ordinary, for main line trains continues to increase as does the luxurious style of fittings. Little that is new in construction has occurred—the most notable being some new 56 ft. bogie coaches on the Great Central, made

of varnished teak, with the match-boarding style of sides instead of the usual panelling, the numerals being in raised metal. Also may be mentioned the new bogie observation car built by the London and North-Western to run between Llandudno and Blaenau Festiniog. This car, built as an attraction for tourists and widely advertised, is after all only the modern successor of a very small one run over twenty years ago by the same company and on the same route.

Some notable retirements from active railway service have taken place, the chief being Lord Stalbridge from the chairmanship of the London and North-Western, Sir Ernest Paget from the chair of the Midland, Sir Charles Owens from the general managership of the London and South-Western, and Mr. Ivatt from the position of locomotive and carriage superintendent on the Great Northern.

Through the courtesy of chief mechanical engineers John G. Robinson of the Great Central and Vincent L. Raven of the North-Eastern, we are able to reproduce illustrations of four representative locomotives.

THE WELL-EQUIPPED MASTER MECHANIC'S OFFICE.

By Louis Brentnall.

In these days a well-equipped office is an important essential with every master mechanic.

Generally, there is little, if any, objection to a master mechanic improving his office where he can do so by using shop labor and such materials as are in his stock. A new floor, new wainscoting and a day's use of the paint brush transforms an otherwise ill-looking office into an acceptable working place for office men. A large room may be partitioned, with the master mechanic's portion of the office to one side, so that employes on routine business need not disturb him. An alert chief clerk should be able to handle affairs generally, referring only such special matters to the master mechanic as require technical knowledge or authoritative dispensation.

Technical books, charts, blueprints and special data should all have a place in a book case or cupboard where they can be readily obtained for reference. A chart of the division, in enlarged size, is especially useful where it shows the distance between points, the facilities of small shops or roundhouses, number of men employed, etc.

One clerk, preferably the chief clerk, should handle all mail, after the office boy has opened it and affixed the office stamp. If the master mechanic wishes to know about some special case, the chief clerk can tell him its status or hand him the papers.

The old-time practice of running around the shop to obtain information has become antiquated since the telephone has come into general use, and in many shops every foreman can be reached by phone and information obtained as to when a certain engine or car will be out of the shop without the necessity of the chief clerk or master mechanic leaving his chair. In other cases, the office boy may be dispatched to the shop with a note. This lessens the number of visits to the different departments and facilitates the handling of work in both shop and office.

Today is especially a time when work of all kinds is being handled on a cost basis; that is, the cost of every job is figured closely, and current figures compared with past data to ascertain whether costs are running high. Such costs can be computed much better where everything pertaining to a weekly or monthly period is put into current reports, instead of allowing some of the data to tail over into the following months. Office work is facilitated by the chief clerk having a list of all reports received or rendered, showing data of issue, and any other reference required. In this way nothing is overlooked.

In his pocket the master mechanic may carry a small record book containing special information, such as a synopsis of the specifications of different engines—sizes of cylinders, drivers, etc., as well as data pertaining to costs, output, equipment undergoing repairs, and so on, the data being kept up-to-date by the clerks.

A deficiency in some master mechanics' offices, which usually results in handling the office work inefficiently, is a limited office force, consisting generally of a timekeeper, who is kept busy recording daily the time worked; a distribution clerk, who keeps track of labor expenditures and materials used, and a chief clerk; while general matters continually coming up must be handled in connection with the rapidly accumulating routine. Where a master mechanic needs another clerk he may find a plea for better office facilities a better course than asking for authority for installing another clerk. An adding machine for adding up time returns, payrolls, distribution and material figures will pay for itself in a few months in the average railroad office. Letters need not be copied in a book, as formerly, for carbon copies can readily be made for both the letter-book and bundle of correspondence. Letter-writing can be shortened one-half by first considering the three or four points pertaining to a subject, and then writing as briefly as possible on these points. Duplicating machines are especially useful in sending fac simile letters to the foremen at the different points on the division or line. Devices which do the duplicating by using a special typewriter ribbon are easy to handle for small uses, while the mimeograph is essential for making a large number of copies of one letter.

A special file for the master mechanic's desk is a great convenience. This may be simply a wooden holder or box with an alphabetical index, into which papers may be placed in a hurry and found when wanted. A card index tray may be used for special memorandums, by writing notes on cards and filing them in the tray under dates or special index tabs. Loose-leaf books of different kinds are also time-savers or a convenience when used for special purposes.

The work of a well-equipped master mechanic's office is greatly facilitated where a dependency is placed upon the foremen of different shop departments to supervise the men and work, and report to the office promptly all data as due, rather than to allow the furnishing of information to run so far behind that it loses some part of its value or purpose.

Time clocks afford the best means, generally, of registering men in and out of the shop, as the men register on cards and are practically their own timekeeper, while the office timekeper records in his time book the time shown on their cards.

Special forms are almost a necessity in expediting the handling of the clerical work of a master mechanic's office, these being such as meet individual requirements. Boiler repairs may be indicated by having the diagram of a boiler printed on a sheet or card, with blank space for writing a few words of necessary explanation. The same pertains with car repairs, by having a card carry the outline of a freight car, with space for showing the number of bolts or boards applied. Forms containing columns with special headings can be devised to suit requirements by using the mimeograph or hecktograph.

A blueprint window in the office or shop facilitates office work as well as shop work. A number of officials may wish to know what the damage was to certain equipment. A rough sketch will show this, and the one sketch answers for sending all inquirers, with a few words of explanation. Such prints may show estimated cost of repairs, as well as other data.

Messages require prompt handling. Where the master mechanic's office is remote from the telegraph office the office boy should make trips to it at certain times during the day. Incoming messages may be phoned by the operator, but outgoing messages should generally be delivered at the telegraph office to obviate error.

Smoke Abatement Tests at Chicago, A. T. & S. F. Ry.

(Copyrighted by Horace G. Burt.)

The Chicago Association of Commerce Committee on Smoke Abatement and Electrification of Railway Terminals has recently issued bulletin number six, giving results of tests made on Santa Fe switching locomotives in actual service at the Chicago yards. These tests were made by H. B. MacFarland, engineer of tests for the Santa Fe and are very comprehensive.

The subject of smoke abatement has received the attention and consideration of the Atchison, Topeka & Santa Fe Railway during many years past. Not only has it been desirable on the part of the railroad company to eliminate smoke from its locomotives on account of the 'smoke nuisance," so called, but on account of the increase in fuel economy and the increase in general efficiency and steaming qualities of the locomotive that operates without making much smoke.

During the past eight or nine years a great many smoke consumption devices have been applied to locomotives in Chicago, in order to reduce the smoke. Some of the appliances thus tried have been on engines for several years. Of the various apparatus applied to the different engines for the reduction of smoke, few had any value in reducing the total amount of smoke delivered from the stack. Devices were for the most part simply aids for the dilution of the smoke made in the firebox.

The most important apparatus of all applied to the locomotive for the reduction of smoke is the brick arch. The arch is of value in the reduction of smoke because it aids in maintaining uniformity of temperature of the gases in the firebox even though there is great irregularity in conditions of operation of the locomotive.

For the complete combustion of coal, two things are necessary: first, a sufficient quantity of oxygen; second, a sufficiently high temperature. Smoke may be properly defined as the result of the combustion of fuels other than those of pure carbon. Smoke as generally recognized, however, consists largely of a mixture of the products of combustion of carbon and oxygen, such as carbon dioxide, carbon monoxide, heavy hydro-carbons and other gases.

When the products of combustion contain to any extent free carbon as well as a quantity of tarry or hydro-carbon vapors, the resultant mixture is usually recognized as smoke. The degree or grade of smoke depends upon the quantity of tarry vapors present in the mixture.

If, in the burning of coal containing a large percentage of volatile matter, the temperature of the resultant gases can be maintained sufficiently high and uniform for a considerable period of time, then the tarry vapors in the smoke will be greatly reduced. Unfortunately, however, the construction of our locomotives is such that in the same chamber or firebox, the process of ignition and combustion of gases is accompanied with the extraction of heat from the gases, so that a uniformity in temperature of gases is not maintained.

The installation of a brick arch in the firebox results in the maintaining of gases at a uniform temperature and also delays them from giving up heat to surrounding cooler mediums until the process of combustion is complete.

Tests were made at different times of various smoke devices, applied to locomotives. Arrangements were made, about two years ago, to supplement these smoke-reducing devices by changing the grade of coal so as to reduce the amount of smoke issuing from locomotives to a minimum and to keep the smoke down, if possible, to such an extent that penalties would not be imposed on the part of the municipal government of Chicago on account of the density of smoke coming from Santa Fe locomotives.

The results of tests made at that time were so favorable on account of smoke from the coal that a change was made from Illinois coal, then being used on Santa Fe switch engines in Chicago, to Pocahontas coal, even though the cost for the Pocahontas coal was 75 per cent greater than for the Illinois coal.

The object of this test was to obtain an exact record of the smoke issuing from a Santa Fe locomotive in regular switching service in and around the 18th Street Yards, Chicago. A further object of the test was to determine, if possible, the total amount and the size of the cinders thrown out by these switch locomotives. It was also desired to establish a comparison of the results now being obtained with the percentage of smoke and cinders that would issue from a locomotive in regular and ordinary service if Illinois coal were used as formerly, instead of Pocahontas.

Santa Fe switch engine 2024, in regular switching service in the passenger coach yards at 18th Street, Chicago, was equipped for comparative tests. This engine is equipped with a brick arch. Test runs were made with this engine, using Pocahontas coal and also using Illinois coal. The tank was calibrated and fitted with water gauges, so that the water consumption could be determined. Connections were tapped into the smoke box so that samples of flue gas could be drawn off for analysis.

It was found desirable to determine the character and amount of cinders thrown out of the stack by the engine when in operation. A specially designed cinder catcher, shown in the illustration, was used for this purpose. In this apparatus, a portion of the stack area, in the form of a sector of a circle, laid off to be a definite percentage of the total stack area, is covered with a special hood. This hood conducts all of the smoke and cinders entering this known area, into a sheet iron hopper where the solid matter is separated and collected at the bottom, and the smoke is liberated to the atmosphere. The hood was shifted about the stack during tests in order to collect an average sample of exhaust products.

Observations were first taken of this engine using Pocahontas coal in regular switching service in the 18th Street and Corwith Yards, Chicago. Data were secured during two one-day tests.

All observations were made upon a time basis: A continuous log, showing density of the smoke, coal fired, use of injector, use of blower, and steam jet operation, was recorded as well as the number of cars handled at any given time, starts, stops, periods of standing, and any other data bearing upon the general performance of the engine. These data have been plotted in chart form for a one-day test and are shown in the illustration.

Readings were taken at the time of each change in operation and the duration of that operation was noted, so that the plotted results show the exact performance and condition of operation of locomotive at any given time. This chart then gives opportunity for a very complete study of the bearing the various operations in locomotive performance have toward one another in the production or abatement of smoke.

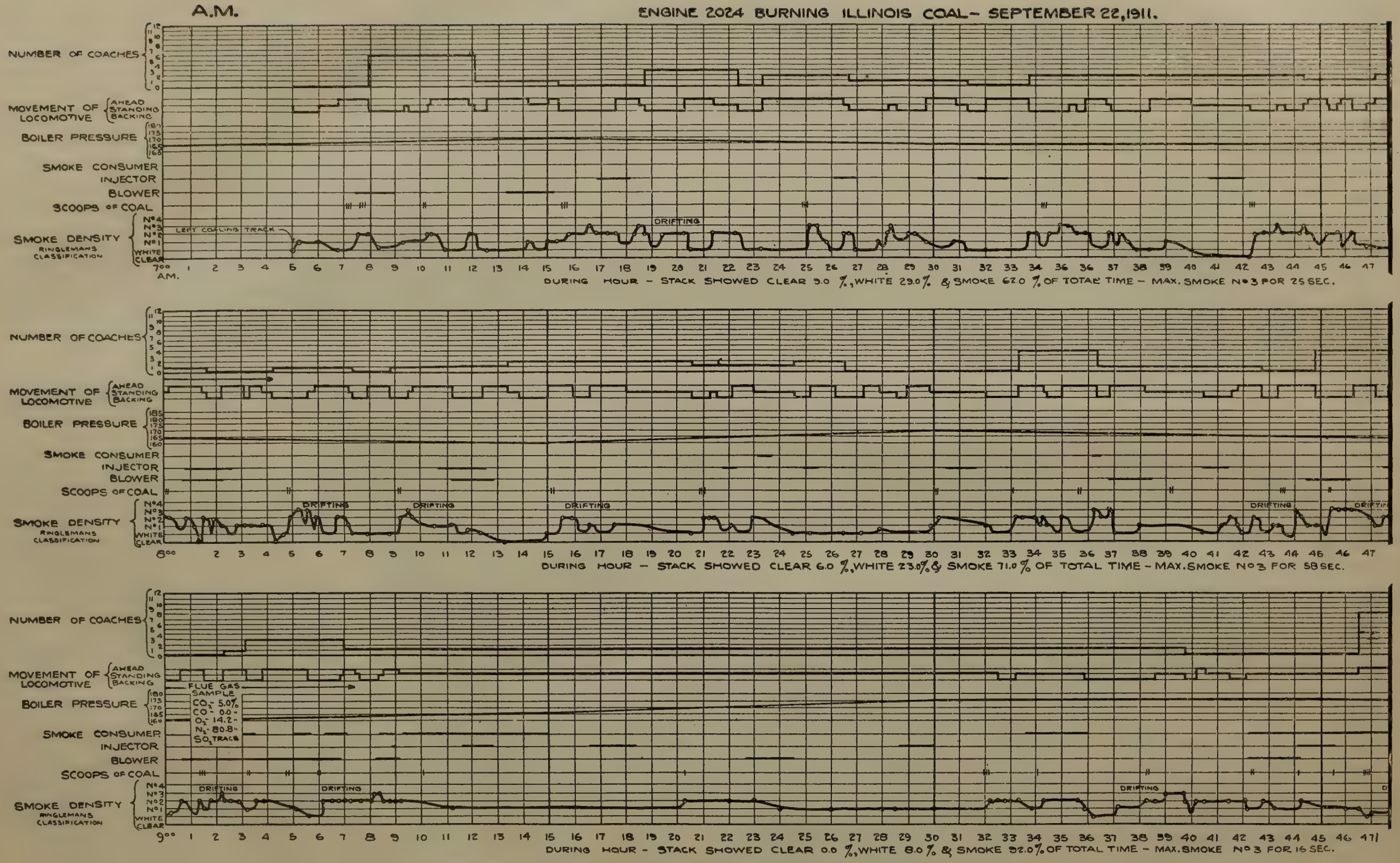
Readings of water gauge glasses on tank were taken only at time of stops and the evaporation was calculated on the total water and coal figures for the day.

Smoke observations were based upon a comparison with Professor Ringelmann's smoke charts. No attempt was made to determine a finer gradation of smoke between densities as shown by Professor Ringelmann's charts 1, 2, 3 and 4, i. e., 20, 40, 60, and 80 per cent, as the transition from one grade to another was accomplished too quickly to record intermediate densities.

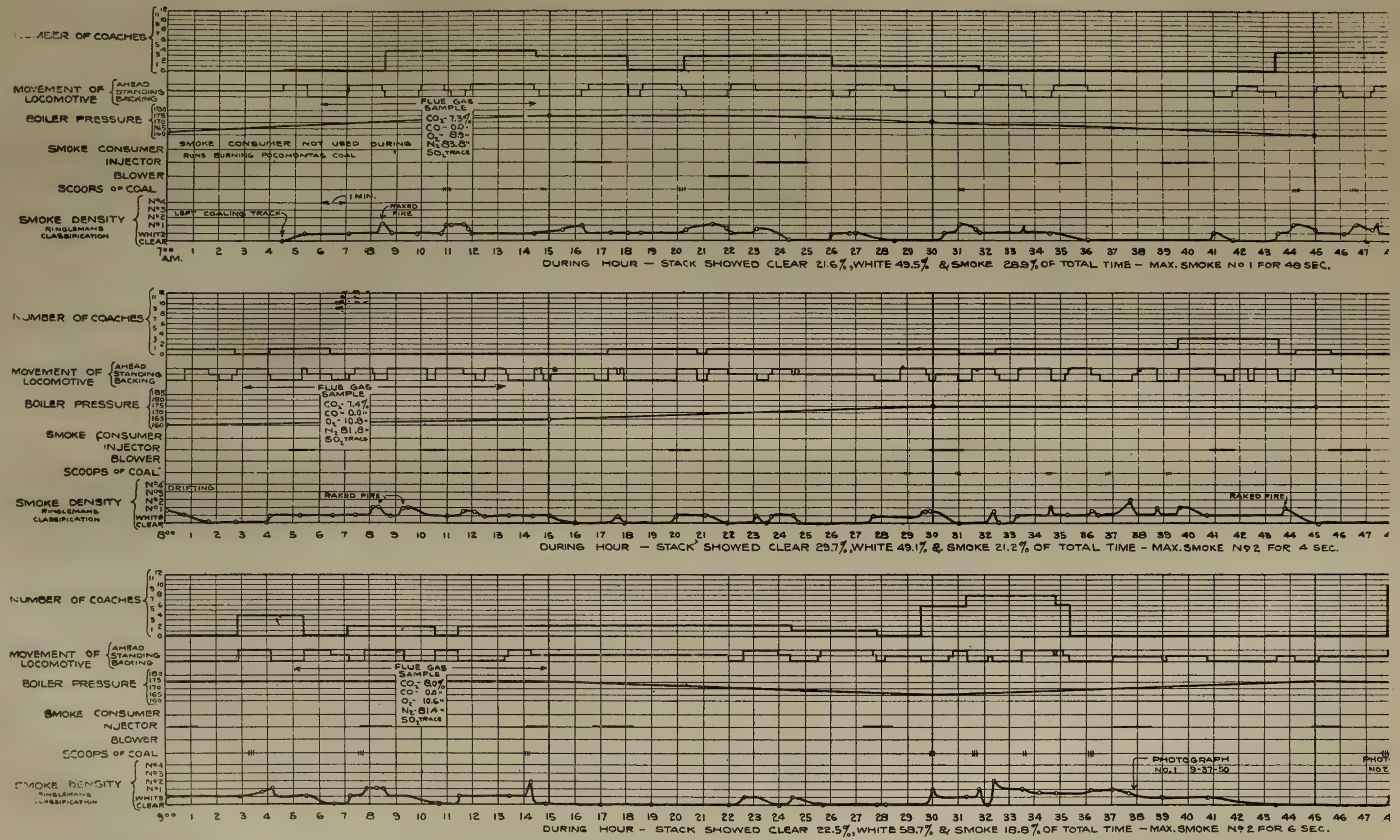
Samples of flue gases were drawn every hour during an interval of approximately ten minutes, regardless of conditions of operations so that the results give an average for the entire day's run.

After the completion of the tests with the Pocahontas coal, the same engine was fired with Illinois coal and a day's test was made, similar observations being made as during the test of the Pocahontas coal.

In making a general study of the smoke density for the period shown in the typical day's test, three classifications are made, viz., "smoke," "white," and "clear." The term "smoke"


A.M.
ENGINE 2024 BURNING ILLINOIS COAL- SEPTEMBER 22,1911.
NUMBER OF COACHES
MOVEMENT OF LOCOMOTIVE
AHEAD
STANDING
BACKING
BOILER PRESSURE
SMOKE CONSUMER
INJECTOR
BLOWER
SCOOPS OF COAL
SMOKE DENSITY
RINGLEMANS CLASSIFICATION
No 4
No 3
No 2
No 1
WHITE
CLEAR
LEFT COALING TRACK
DRIFTING
7 00 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47
A.M.
DURING HOUR - STACK SHOWED CLEAR 3.0 %, WHITE 29.0% & SMOKE 68.0 % OF TOTAL TIME - MAX. SMOKE No 3 FOR 25 SEC.
NUMBER OF COACHES
MOVEMENT OF LOCOMOTIVE
AHEAD
STANDING
BACKING
BOILER PRESSURE
SMOKE CONSUMER
INJECTOR
BLOWER
SCOOPS OF COAL
SMOKE DENSITY
RINGLEMANS CLASSIFICATION
DRIFTING
8 00 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 46 46 47
DURING HOUR - STACK SHOWED CLEAR 6.0 %, WHITE 23.0% & SMOKE 71.0 % OF TOTAL TIME - MAX. SMOKE No 3 FOR 58 SEC.
NUMBER OF COACHES
MOVEMENT OF LOCOMOTIVE
AHEAD
STANDING
BACKING
FLUE GAS SAMPLE
CO2 - 5.0%
CO - 0.0 -
O2 - 14.2 -
N2 - 80.8 -
SO2 TRACE
BOILER PRESSURE
SMOKE CONSUMER
INJECTOR
BLOWER
SCOOPS OF COAL
SMOKE DENSITY
RINGLEMANS CLASSIFICATION
DRIFTING
9 00 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47
DURING HOUR - STACK SHOWED CLEAR 0.0 %, WHITE 8.0 % & SMOKE 92.0% OF TOTAL TIME - MAX. SMOKE No 3 FOR 16 SEC.

Typical Performance Sheet of Switching Locomotive Burning Illinois Coal.



Typical Performance Sheet of Switching Locomotive Burning Pocahontas Coal.

includes all grades from vapor to the maximum. By "white" is meant the absence of any color to the exhaust at time of observations. When "clear" neither smoke nor exhaust could be seen, nothing but a colorless heat vapor being given off.

Based upon the above classification, a division of the stack gases for the day's test with Pocahontas coal, and also with Illinois coal, shows as follows: The division is based upon the percentage of total elapsed time:

Stack Gases	Pocahontas	Illinois
White	34 per cent	18 per cent
Clear	42 per cent	2 per cent
Smoke	24 per cent	80 per cent

During the test with Pocahontas coal no smoke above the grade of No. 4 was observed. The average duration of smoke was from three to eight seconds, the smoke lasting only from four to eight exhausts after a given firing period, the stack then clearing up and showing white. The extreme periods of smoking occurred at times fire was raked or just after the engineer had shut off steam and the locomotive was allowed to drift. With the Illinois coal the maximum grade of smoke observed was No. 4, no dense black smoke being observed at any time. Not only was the duration of smoking periods greater than with the Pocahontas coal but the average density of the smoke was much higher.

The coal consumption was determined by recording the number of scoops of coal fired and multiplying the average weight of a scoop of coal by this amount. The average weight per scoop was determined by throwing aside an occasional scoop during firing periods, and then weighing this amount to determine an average weight per scoop. Results obtained were as follows:

During a period of nine hours and forty-seven minutes, 251 scoops of Pocahontas coal were fired, and during a period of nine hours and twenty-seven minutes, 283 scoops of Illinois coal were fired. Results obtained were as follows:

	Pocahontas.	Illinois.
Average weight per scoop, pounds	15	15.25
Total coal fired, pounds	3,765	4,320
Consumption per hour, pounds	386	457

Water consumption was determined by means of gauge glasses placed at each of the four corners of the tank. The tank was carefully calibrated before the tests. An average of the readings of the four levels was taken as the true level of the tank. The temperature of the feed water averaged about 65 degrees Fahrenheit, throughout the series of tests. Allowing 1.5 per cent of total water used out of tank as injector overflow, evaporation figures are as follows:

	Pocahontas.	Illinois.
Water supplied to injector, pounds	34,470	29,265
Water wasted by injector, pounds	520	440
Water delivered to boiler, pounds	33,950	28,825
Total coal burned, pounds	3,765	3,797
Pounds of water evaporated per pound of coal fired	9.0	7.6

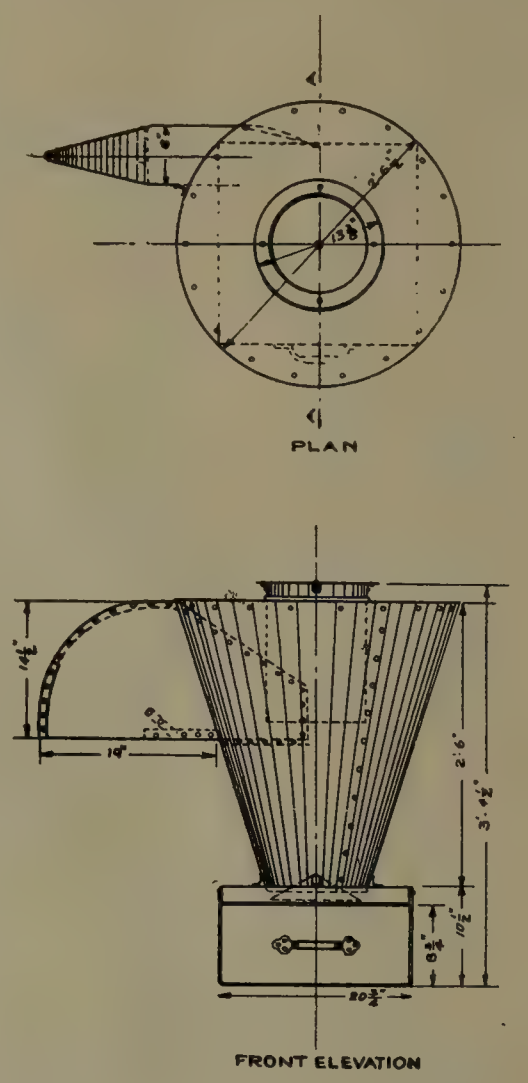
A composite sample of each of the different coals was obtained in accordance with standards outlined by the American Society of Mechanical Engineers. The heating value of the coals was determined by use of a Mohler bomb calorimeter. The volatile matter, fixed carbon, ash, etc., were determined in accordance with standard methods of the American Chemical Society. The proximate analysis follows:

	Pocahontas.	Illinois.
Moisture, per cent	1.76	0.45
Volatile matter, per cent	17.21	30.87
Fixed carbon, per cent	74.08	60.99
Ash, per cent	6.91	7.69
Sulphur, per cent	1.06	2.34
Heating value, B. t. u. per pound	14,085	13,331

A composite sample of ash taken from the ash pan during each day's test analyzed with results as follows:

	Pocahontas.	Illinois
Moisture, per cent	0.59	0.61
Volatile matter, per cent	7.85	3.97
Fixed carbon, per cent	43.90	48.17
Ash, per cent	47.65	48.25
Sulphur, per cent	0.17	0.15
Heating value, B. t. u. per pound	8,241	5,266

The special cinder hopper was used throughout each day's test. This device served to divert 10.87 per cent of the total amount of exhaust gases passing out of the stack. The solid matter was separated and retained; the smoke was liberated.



Cinder Catcher, Santa Fe Smoke Tests.

The position of the hopper inlet in relation to the stack was changed from time to time in order to obtain results that would reflect an average condition. Knowing the relation of the area of the hopper inlet to the area of the stack, the entire amount of cinders passing out of the stack could be estimated from the amount caught and retained by the hopper.

The results were as follows:

Pocahontas Coal.

Total elapsed time, 9 hours 47 minutes.	
Dry weight of cinders caught, pounds	2.75
Estimated weight total cinders thrown from stack, pounds	29.88
Estimated total weight cinders thrown from stack per hour, pounds	3.17

The ratio, then, of pounds of coal fired to pounds of cinders thrown from stack is 1 to 0.0082. This ratio gives 16.4 pounds of cinders passing from the stack per ton of coal fired or only 0.82 of 1 per cent of coal fired going from the stack in the form of cinders.

In 1910, 22,608 tons of Pocahontas coal were fired in Santa Fe switch locomotives in Chicago. At the ratio of 16.4 pounds of cinders per ton of coal fired, 185 tons of cinders were thrown from locomotives in 1910.

Illinois Coal.

Total elapsed time, 9 hours 27 minutes.	
Dry weight of cinders caught, pounds	3.06

Estimated weight of cinders thrown from stack for entire day, pounds	32.65
Estimated total weight cinders thrown from stack per hour, pounds	3.46

The ratio, then, of pounds of coal fired to pounds of cinders from the stack is 1 to 0.0076. This ratio gives 15.2 pounds of cinders passing out of the stack per ton of coal fired or only 0.76 of 1 per cent of coal fired going out of the stack in the form of cinders.

In 1909, 24,714 tons of Illinois coal were fired in Santa Fe switch locomotives in Chicago. At the ratio of 15.2 pounds of cinders per ton of coal fired, 188 tons of cinders were thrown from locomotives in Chicago during 1909.

An analysis of the cinders from the stack was made with the following classification as determined by mesh of sieve.

	Pocahontas	Illinois
	Per Cents	
Passing through 100 mesh sieve	50.00	62.50
Passing through 50 mesh sieve	14.28	12.50
Passing through 30 mesh sieve	14.28	12.50
Passing through 20 mesh sieve	7.14	6.25
Coarse cinders	14.30	6.25

A proximate analysis of the cinders gave the following results:

	Pocahontas	Illinois
Moisture, per cent	1.38	1.34
Volatile matter, per cent	11.73	6.95
Fixed carbon, per cent	27.40	39.41
Ash, per cent	59.49	52.30
Sulphur, per cent	0.59	0.26
Heating value, B. t. u. per pound	4,362	6,103

The figures obtained in this study of cinders thrown from stack of locomotives in switching service discredit the popular theory of great heat value losses due to cinders passing out of the stack. In Goss's "Locomotive Performance," figures are given for laboratory tests under various working conditions of locomotive showing losses in the form of cinders passing out of the stack varying from 2.8 per cent to 10 per cent of the total coal fired. The results of test on engine 2024 in Chicago Yards, show for Pocahontas coal but 0.82 of 1 per cent of the total coal fired passing out of the stack in the form of cinders. These cinders contained but 4,362 heat units to the pound whereas the coal initially contained 14,085 heat units to the pound, so that the loss in cinders passing out of the stack, expressed in heat units, is but 0.25 of 1 per cent of the total coal fired.

When firing Illinois coal, the total cinders were 0.76 of 1 per cent of the total coal fired. These cinders contained 6,103 heat units to the pound, whereas the coal initially contained 13,331 heat units to the pound, so that the loss in cinders passing out of the stack, expressed in heat units, is but 0.35 of 1 per cent of the total coal fired.

Samples of flue gas were drawn every hour over a period of approximately ten minutes. No consideration was given to the conditions of operation at time of taking samples so that the results obtained reflect average conditions for the day. Following are the average results of hourly analyses made during each day's test:

	Pocahontas	Illinois
	Per Cents	
Carbon dioxide	8.0	6.8
Carbon monoxide	0.0	0.0
Oxygen	9.6	11.9
Nitrogen	82.4	81.3
Sulphur dioxide	Trace	Trace

The charts show graphically the typical performance of Santa Fe switch locomotives in regular service in Chicago Yards. The results as plotted show actual every-day conditions and may be studied as representative of the performance of all switch engines around 18th Street Yards in regular practice. The density of smoke at any time during the day, the time of firing, the number of scoops of coal fired at a time, time injector, blower and smoke consumer were on or off direction of travel, number of cars handled, flue gas analysis, etc., are plotted upon a time basis, so that the relation between these various operations may be studied and their effect on abatement or production of smoke determined.

The short duration of smoke when the fuel is Pocahontas coal was particularly noticeable in the difficulty experienced in obtaining photographs to represent typical conditions. An attempt was first made to secure the photographs as the locomotive passed a fixed point but it soon became evident that the only way to secure photographs that would satisfactorily represent conditions, was to secure the photographs from some position upon the locomotive where they could be snapped at a moment's notice. With such an arrangement the operator experienced difficulty in catching a given picture at the desired time, owing to the rapid transition of smoke density from a condition of "smoke" to "clear" or "white."

The analysis of flue gases shows very complete combustion of gases for both fuels. This condition is to be expected on locomotives in this class of service, where the work is comparatively light and it is not found necessary to force the fire at any time during the day.

The large percentage of oxygen present in the flue gases shows that a large excess of air was admitted so that the flue gases are highly diluted. This condition accounts for the low percentage of carbon dioxide.

The analysis of the coals shows a higher calorific value for the Pocahontas coal. The heating value of the ash, however, which forms a small per cent of the total coal fired, shows a greater thermal content in the ash of the Pocahontas coal than that for the Illinois coal. The higher calorific value of the Pocahontas ash may be attributed to the coking properties of this coal, as it was frequently necessary to break up the surface of the fire with the hook and a quantity of coke worked through the grates each time.

The calorific value of the cinders caught in the cinder hopper was 42 per cent greater for the Illinois coal than for the Pocahontas coal.

The cinders from the Pocahontas coal caught in the cinder hopper are slightly coarser than those caught when firing with Illinois coal.

Conclusions.

(1) The recorded results show that the total smoke from switch engines is much less in intensity from the use of Pocahontas than from the use of Illinois coal.

(2) The duration of the maximum density period of smoke is much shorter for Pocahontas than for Illinois coal.

(3) The total amount of smoke is much less for Pocahontas than for Illinois coal.

(4) The stack showed "white" for 34 per cent of the time with Pocahontas coal as against 18 per cent of the time with Illinois coal.

(5) The stack showed "clear" 42 per cent of the time with Pocahontas coal and only 2 per cent of the time with Illinois coal.

(6) The stack showed "smoke" 24 per cent of the time with Pocahontas coal as against 80 per cent of the time with Illinois coal.

(7) The analysis of the gases showed no per cent of poisonous carbon monoxide gas present at any time for either of the coals.

(8) A large per cent of excess air insuring complete combustion was present at all times.

(9) There were traces only of sulphur dioxide in all samples of gases from both coals.

(10) The evaporation per pound of fuel was greater for Pocahontas than for Illinois coal, being only 85 per cent as much for the latter as for the former coal.

(11) The fuel consumption per hour was light, averaging 386 pounds for the Pocahontas and 457 pounds for Illinois coal.

(12) The amount of cinders thrown from the stack was very small, being only about sixteen pounds per ton of coal fired.

(13) The steam jets were rarely used when burning Pocahontas coal; they were frequently used in order to hold down the density of the smoke when burning Illinois coal.

(14) In general the results of test indicate a very decided reduction in total amount of smoke from the use of Pocahontas instead of Illinois coal on Santa Fe switch engines in Chicago.

ALBINA SHOP BUILDING, O-W. R. & N.

The Oregon-Washington R. R. & N. is erecting a building at Albina, Ore., for woodworking and freight car repairs, the dimensions being 150 ft. by 400 ft. The freight car repair shop is 80 ft. by 400 ft. and the woodworking shop 70 ft. by 400 ft., the building being of frame construction with a concrete foundation. The trusses have 70 ft. and 80 ft. spans, with 20 ft. centers, and the height from the top of the rail to the under side of the bottom chord of the trusses is 20 ft., the sash supporting the trusses being 12 ft. by 12 ft. The flooring is 3 in. by 8 in. rabbeted plank on sleepers and the outside walls have 6-in. studding between posts, are wood sheathed and covered with corrugated galvanized iron. The roof is of 1½ in. by 4 in. fir and is covered with three-ply Brooks roofing made by the Johns-Manville Co. There is a clere story 10 ft. wide longitudinally through each section and the clere story sash are in series of five and are controlled by the Harris operating device. At each end of the building are four steel rolling doors. There are four tracks through building, one through center line of woodworking shop and three through car repar shop. There are three compressed air main lines through building overhead, one through center of building and one on each side of building with branch lines running down posts with air cocks 3 ft. 6 in. above floor. The machines in the woodworking shop are motor driven and an overhead blower pipe system has been installed to carry shavings from the machines. The building is lighted with enclosed arc lights and incandescent drop lights over each machine; also on center line of posts there are receptacles for extension lights used in working in and around cars. Steam heat is supplied by the vacuum system. The toilet and wash room in connection with the building are on the car repair side. The Clow automatic flushing water-closets and J. L. Motts double wash trays and urinal troughs are being installed.

The dry kiln is 40 ft. by 70 ft., of frame construction, covered with corrugated galvanized iron. The kiln is divided into three sections, each 70 ft. long by 12 ft. 6 in. wide, with track running through each section; foundations of concrete; floor of concrete 2 ft. 6 in. below tracks. They are heated by steam with pipe radiation between and below tracks. The entrance doors to kilns are of canvas.

The lumber shed is 50 ft. by 300 ft., with 50-ft. trusses and 15-ft. centers. The building is open on both sides, but the ends are closed in. It is sheathed and covered with corrugated galvanized iron, roof of corrugated galvanized iron; tracks either side parallel and longitudinal of building. The contractor in charge is W. N. Concannon, of San Francisco.

REFRIGERATOR CARS, MERCHANTS DESPATCH.

The illustration shows one of an order of 60 express refrigerator cars recently built and put in service by the East Rochester, N. Y., shops of the Merchants Dispatch Transportation Co. They are equipped for passenger service as well as freight service, have continuous buffers, 12 in. air brake equipment, signal apparatus and steam conveyor. Fox trucks with an especially designed swing-motion for this service are used, together with solid steel wheels and Miner friction draft gear. Steel underframes built at the steel plant o Merchants Dispatch are used and the cars have outside steel roofs. They are of 40 tons capacity, with an ice capacity of 11,000 pounds, and a total weight of 62,800 pounds. The length over all is 41 ft. 5½ ins. The East Rochester shops have a capacity of 15 to 16 cars of this type per day.

Refrigerator Car for the Merchants Despatch.

ELECTRIFICATION OF LONDON, BRIGHTON & SO. COAST RY.

One of the most important of the world's electrification projects is that of the London, Brighton & South Coast Ry.

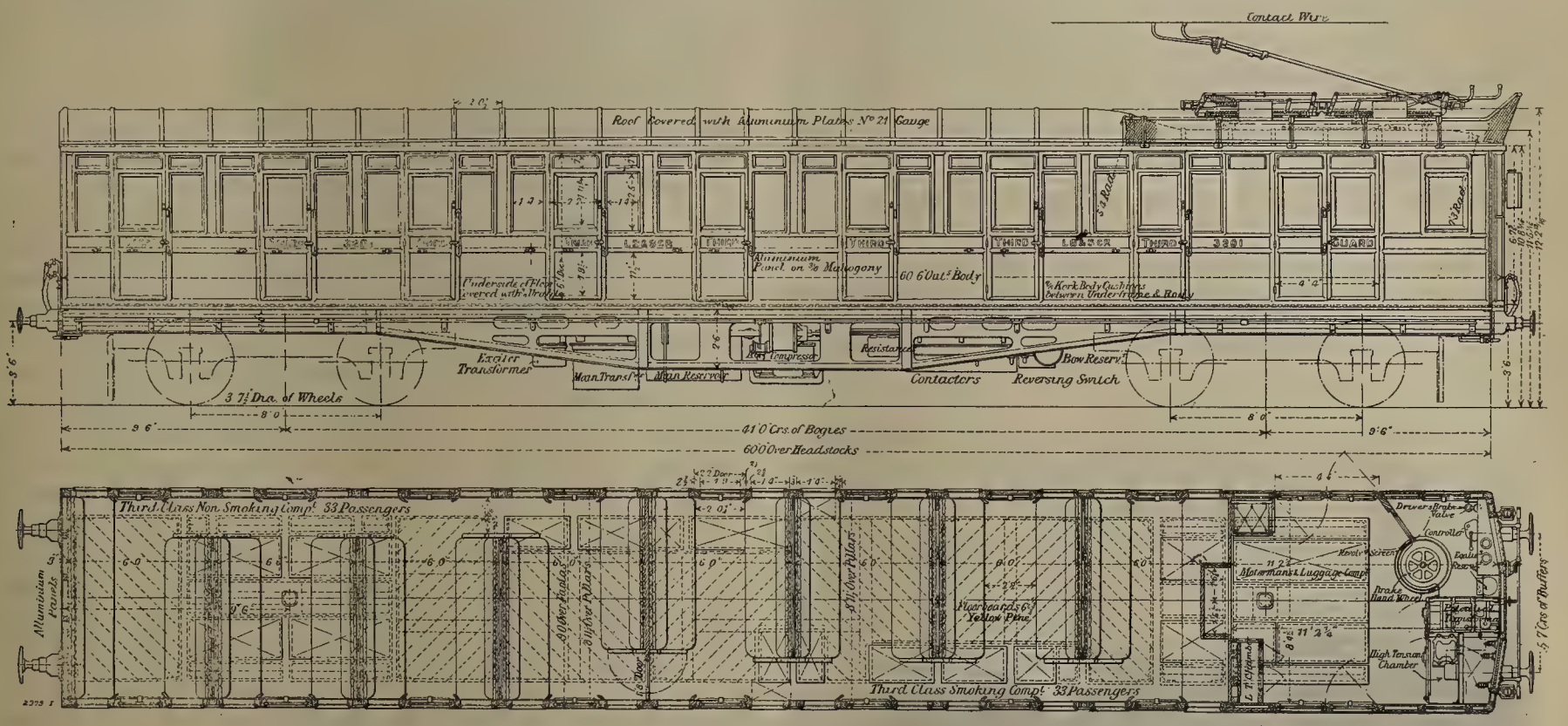
The following information with respect to the electrically operated rolling stock of this road with the illustrations is taken from Engineering (London).

Although the mechanical features of a single-phase rolling-stock do not necessarily differ from those of a direct-current one, there are, none the less, apart from the electrical equipment, many details in the stock which has been built for the Brighton Railway which distinguish it from the type which has become familiar in connection with electric traction in England. Of these the most immediately obvious is the arrangement which has been adopted for the positions of the doors and distribution of the seats in the coaches used. The employment of the American type of coach, with end doors and a central corridor, on the London Underground Railways, the Mersey Railway, the Liverpool and Southport line, and elsewhere, has caused it to become associated with electrical working in the minds both of the public and engineers in this country, although it, of course, has no essential connection therewith. The American type of coach has been held to possess advantages over the usual English side-door type in the handling of large numbers of passengers on a service with many stops, while for tube service, in particular, it allows of the very necessary control of the doors by the train staff. On the Brighton line, however, it was considered that a side-door construction would be better, especially from the point of view of quick emptying at terminals and a special type of coach was accordingly designed.

Two types of coach, differing in the seating arrangements, are in use on the electrified part of the Brighton Railway. Of these, one is confined to work on the South London line, while the other deals with the traffic to the Crystal Palace. The first type of coach has side doors, exactly as in ordinary compartment stock, but at the same time is made open throughout, except for a partition dividing the smoking and non-smoking sections. Open side-corridors are provided, the arrangement of which will be clear from the plan, and it will be obvious that the design gives the large number of doors which facilitate quick emptying at termini, and, at the same time, does away with the necessity for passengers wishing to board the train at intermediate stations running from door to door looking for an empty compartment, since a passenger entering by any door may afterwards walk along the corridor and select a seat when the train has started. The coaches are arranged so that a third-class compartment seat can accommodate four people side-by-side, and a first-class compartment seat three. All of the first-class coaches are arranged as trailers. The over-all dimensions of the stock are 60 ft. long by 9 ft. wide.

On the extension of the electrified lines to the Crystal Palace a new type of coach had to be introduced, since various permanent features of the line, and more particularly the Crystal Palace tunnel, would not allow of the use of a coach 9 ft. wide. A new design, 8 ft. wide and 56 ft. long, of the pure compartment type, was accordingly introduced. The third-class compartments of this stock are arranged to carry five passengers on a seat, and the first class four. The carrying capacity of a third-class motor-coach is 70 passengers, and of a composite first and third trailer 74 passengers, of which 24 are first-class and 50 third-class. As before, all first-class compartments are arranged in trailers. In addition to this new stock, some old coaches have been re-formed and adopted as trailers for the Crystal Palace service. These are all composite first and third-class coaches, and carry 16 first-class passengers and 60 third-class. These re-formed coaches are 50 ft. long.

On the first opening of the South London line the trains were made up of two third-class motor-coaches and one first-class trailer; but experience proved that this arrangement did not give the correct, train-unit, and some composite first and third-class trailers, equipped with controlling gear, have now been built. These coaches allow the trains to be made up of one motor and one trailer, or two motors and two trailers. On the Crystal Palace extension the new stock allows the trains to be made up with any number of coaches from two to six. All trailers are fitted with control gear, and a three-coach train has one motor-coach and two trailers, while a five-coach train has two motors and three trailers. Trains made up of two, four, or six coaches have equal numbers of trailers and motor-coaches. It will be noted that on the South London line at least one motor-coach is required with each trailer, but that on the extension one motor-coach can deal with two trailers. The reason for this lies in the more powerful motors which are fitted



Elevation and Plan of Third Class Motor Coach, L. B. & S. C. Electrification.

to the new stock. The original South London motor-coaches have four motors, each capable of giving an output of 115 force-power for one hour, this size being determined on since it was the largest available motor which had stood adequate commercial tests at the time the stock was equipped. When, however, the coaches for the extension were built, advantage was taken of the more extended experience and motors of 150 horse-power were accordingly installed.

All of the coaches are built of wood, in accordance with the railway company's usual practice; but in order to provide a complete earthed electrical circuit throughout and to eliminate the possibility of any part of a coach becoming charged by leakage from the bow collector, the roof and sides of each coach are covered with sheet aluminum, which is bonded to the underframe. The aluminum sheet, after fixing, has been painted in the usual way, and an excellent finish has been obtained. The flooring of the coaches is double, and between the two layers of planking a space is left, which has been filled in with incombustible slag-wool, while underneath the lowest floor a ¼-in. layer of uralite has been fixed, which in turn is backed up on its lower side with a sheet of aluminium. This arrangement gives an adequate fire-proof protection between the passenger compartments and the wiring and other electrical apparatus carried beneath the body, while the sheet-aluminium protects the uralite and completes the earthed metallic sheathing which embraces the coach.

Standard Train on L. B. & S. C. Ry. After Electrification.

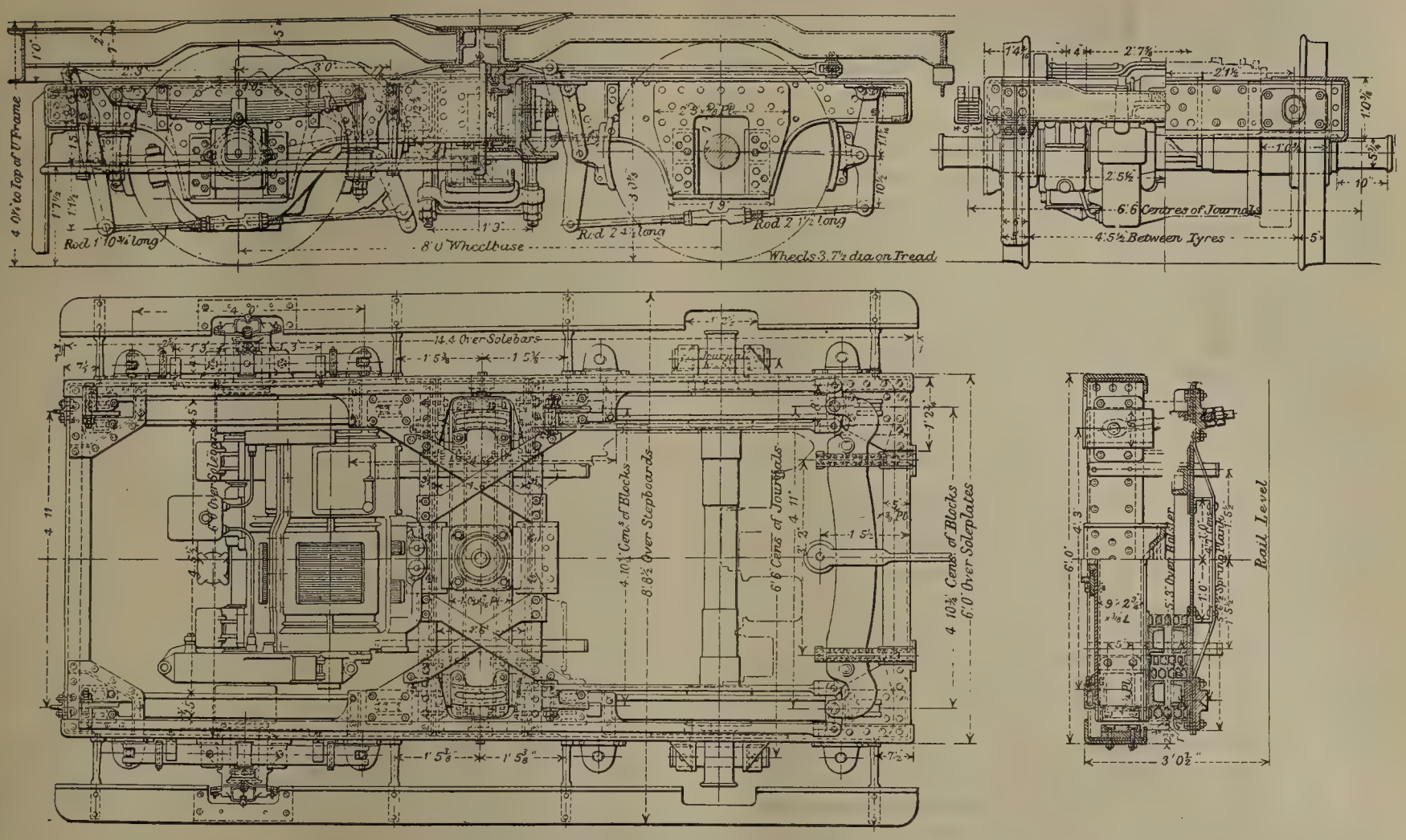
As stated above, each South London motor-coach is equipped with four 115-horse-power motors, and each Crystal Palace motor-coach with four 150-horse-power motors. They are all of the Winter-Eichberg compensated repulsion type. It will be remembered that in this class of motor a rotor wound like the armature of a direct-current motor is used, and that the main brushes are short-circuited. The current supplied from outside to the motor passes through a circuit containing the main stator coils and a small auxiliary exciter transformer. The low-tension part of this transformer is connected to a circuit containing the exciting coils, and passes to the rotor through exciter brushes, which are independent from the main brushes. The transformer-like action between the stator coils and the rotor produces a current in the rotor which exercises a torque on the rotor in virtue of its relation to the field produced by the exciter coils. Speed regulation is carried out by varying the voltages supplied to both the stator coils and the exciter circuit. The motors have four poles, each with six slots, and two compensating coils are set in the middle of two-pole faces of opposite polarity.

Each motor has six sets of brushes, of which four sets are for the short-circuit current of the rotor, and the remainder for the exciter current. The short-circuit brushes are placed opposite the middle of the pole-face, and the exciter brushes at the point of diversion of two adjacent poles. The rotor has a partly hollow shaft, the hole through it being employed for the entry of ventilating air, which is drawn through by the centrifugal action of an aluminium ring at the opposite end of the rotor from the commutator. The air-gap is 3 mm. The synchronous speed of the motor is 750 revolutions per minute, but it is capable of developing torque at speeds higher than this. The normal starting torque is 182 kilog.-m. (1317 pound-feet). The gear ratio is 4.24 to 1. Although the above particulars apply specifically to the 115-horse-power motors in use on the South London line, they apply other than numerically to the newer 150-horse-power motors on the Crystal Palace line.

Each pair of motors works in conjunction with a 220-kw. main transformer, so that there are two of such main transformers on each motor-coach. While, in addition, each pair of motors has an exciter-transformer of the auto transformer type. Starting and speed control are carried out by varying the voltage which is supplied both to the stator and exciter circuits. The main transformer steps down from the 6600-volt supply pressure to a maximum of 750 volts on its secondary side, and by means of contactors, connected to form tappings, the volts supplied to the motor may be made either 450, 580, 640, or the full 750. The voltage of the exciter auto-transformer may also be varied by means of two contactors. It will be clear that the full voltage of the stator circuit is not applied to the commutator, since this latter is short-circuited on itself, so that a relatively high voltage is allowable across the secondary of the main transformer. This is, of course, inherent in the type of motor used, and has the advantage that owing to the relatively high secondary main voltages that can be employed, the currents which have to be handled by the contactors are relatively small.

The operation circuits may be divided into three groups, consisting of the high-tension circuits, the control circuits, and the low-tension power circuits. The high-tension circuit, which enters the coach from the collector bow, and on the diagram begins at the lower right-hand corner, passes first through a choking-coil, to the overhead line side of which a spark-gap and carbon resistance lightning-arrester is connected. The choking-coil serves the usual purpose of diverting any high-frequency oscillations which may appear on the line, and causing them to pass through the lightning-arrester to earth. The coil does not introduce any appreciable impedance in the 25-period supply circuit. After passing through the coil the high-tension current comes to a bifurcation in the circuit, and part of it passes to the main transformer, the remainder going to a small auxiliary transformer which supplies the control, pump and lighting circuits. This auxiliary transformer circuit is protected by a high-tension fuse, which can be seen in the diagram. The main transformer circuit passes through a main fuse, a current-transformer, a main automatic oil-switch, and then through the isolating switches, which may be used to cut off either one or both of the two main transformers on the coach. The remote ends of the main and auxiliary transformers are connected to earth. The opening of the main oil switch does not break the circuit through the auxiliary transformer. This arrangement is made since it is important at all times to maintain the control and lighting circuits, even if the main circuit be interrupted.

Power for the control circuit, as stated above, is obtained from the auxiliary transformer, which has a secondary voltage of 300, one end of the secondary being earthed. The circuit as it issues from the transformer divides into five



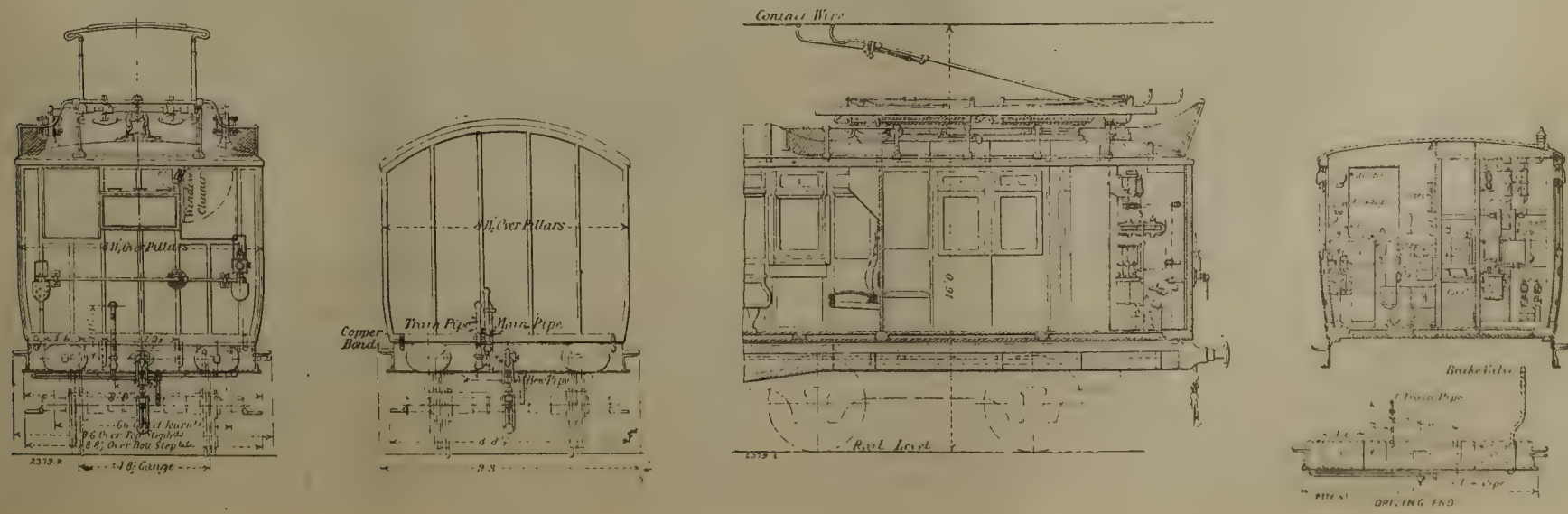
Truck for Third Class Motor Coach, L. B. & S. C. Ry.

branches, two of these being carried to the pump and lighting circuits respectively.

The diagram that the master-controller is dividing into two parts, one part consisting of the drum which operates the contactors, and which is moved by means of the driving-handle, and the other part operating the reversing contacts, and which is moved by means of a small loose handle which can be removed. The two parts of the controller are connected by means of a small bridging-piece, which is operated by means of the so-called "dead man's" handle. This bridging-piece must be held down during the whole of the time that the train is in motion, as when it rises the power circuit is interrupted, and the train is automatically brought to a stop by the brakes. The "dead man's" handle is intended primarily as a safeguard in the event of an accident occurring.

The brakes are of the Westinghouse type, which is the standard of the Brighton railway.

Each motor-coach is arranged with a driver's compartment at one end. The high-tension control apparatus, together with the master-controller and other driver's gear, is carried in this compartment. The contactors, main transformer, and brake-gear are slung below the coach. The roof of the compartment and the guard's van has been made lower than that of the rest of the coach; this has been rendered necessary owing to the limited space available for the bow-gear. The high-tension gear in the driver's compartment is, of course, quite independent from the driving-gear, and is fitted in a separate cubicle. This cubicle contains the lightning-arrester, the main fuses, the isolating switches, the main oil-switch, and the auxiliary and current-transformers, which have been already mentioned, together with current and potential transformers for the integrating wattmeter and the voltmeter and ammeter which are fitted on the coach. The door of the cubicle is interlocked with the bow-gear in such a way that when the door is opened the bow leaves the overhead wire, so that no access can be had to the high-tension gear when it is alive. The interlocking arrangement is a mechanical one, and consists of two arms, which are connected to the bow mechanism in such a way that they foul the cubicle door and prevent it from being opened when the bow is in its lifted position. In addition to the mechanical interlock, however, there is an arrangement by which the



Sections of Third Class Motor Coach, L. B. & S. C. Ry.

opening of the door releases the air from the underside of the cylinders which hold the bows in their upper position. As an additional precaution over these arrangements, the opening of the door automatically earths the whole of the gear in the high-tension cubicle.

In addition to this high-tension cubicle there is a low-tension cupboard in each compartment, which contains the lighting-circuit switches, a switch controlling the operation of the main oil-switch, and the connecting-box and cut-out switch for the contactor circuits. This cupboard was originally fitted with a Nernst resistance connected in series with the lighting circuits and intended to maintain constant voltage on the lamps. It has been found, however, that the feeding arrangements of the railway are sufficiently adequate to render any such lamp regulation unnecessary, and the resistances have been done away with. The motor-man's gear contained in the driving compartment is fitted around a window situated at the left-hand side of the front of the train. The window is fitted with a squegee for use in wet weather. The gear consists of the master-controller with its speed-control and reversing barrels, an ammeter, voltmeter, and wattmeter, the red signal-lamps to indicate when the main oil-switch opens, a dead-section switch which enables power to be obtained from the rear bow when the front is on a dead section or vice versa, and the brake-valve, pressure-gauge, and whistle-valve and cut-off cocks for the bow cylinders.

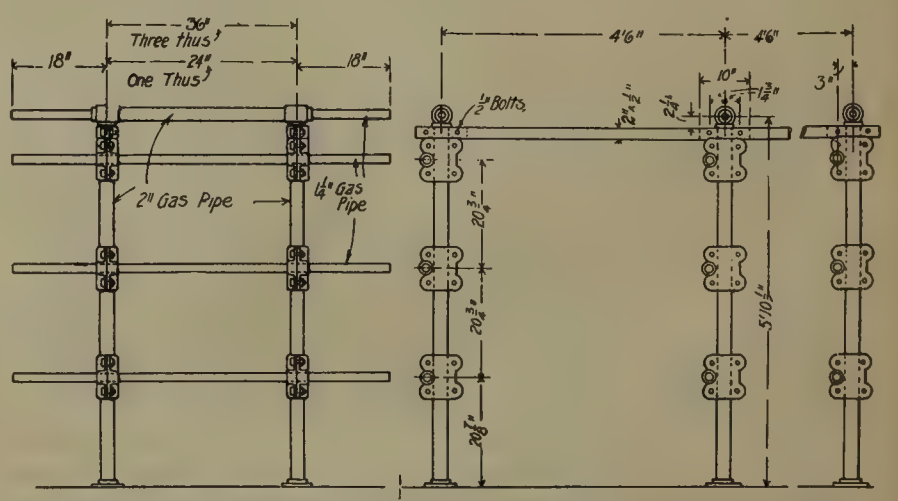
The collector-bow is of much interest on account of the difficult conditions with which it had to be designed to comply. There is a variation of 6 ft. between the highest and lowest positions of the overhead conductors, and as a consequence, of course, it was necessary that the bow should have a working range of 6 ft. In addition to this condition, however, the lowest position of the conductor is such that there is only just over 11 in. clearance between the roof of the coach and the bow and its framework, which are alive at working pressure, and this clearance was only gained by fixing the bow above the guard's van and driver's compartment, and lowering the roof, as before mentioned. Each set of mechanism contains two bows, one being used for each direction of running, and the two being so operated by their reversing switch and air-cylinder mechanism that on reversal in the direction of running of the train the bow in the top position automatically comes down, and that in the lower position rises. The falling bow does not, however, leave the overhead conductor until the rising one comes in contact with it.

Each set of mechanism has two air-cylinders mounted on the centre line of the coach, as shown, and connected to the live part of the gear through insulators, one air-cylinder serving for the operation of each bow. The spiral springs connected to the levers, which are mounted on the shafts which carry the lower ends of the bows, tend to keep the bows in their lowered positions, and the bows are lifted and held in their upper position by the pressure in the air-cylinders, which oppose the springs. The effect of this arrangement, of course, is that the failure of the air-supply causes the bows to come down. The springs and air-cylinders are proportioned so that when the train is standing with the bows on an overhead conductor, fixed 16 ft. above rail-level, a weight of 12 lb. attached to the main collector strip, and a weight of 8 lb. attached to the trailing strip, will just bring the bow off the wire. The springs and air-cylinders are also arranged so that the upward pressure of the bows does not substantially vary over the range of their travel. The collector-strips on the top of the bows are made from aluminium, and are formed each with a longitudinal groove, which is filled with a mixture of vaseline and black-lead. This is found to give a very satisfactory lubrication, and under normal conditions the strips are found to run from 5000 to 6000 miles without requiring renewal. The overhead conductors are staggered to prevent grooving of the strips, and it is found that there is little appreciable wear on these conductors. The collecting-strips are 3 ft. 7¼ in. wide, and the bow over-all is 5 ft. 2 in. wide. The object of the trailing-strips is to ensure continuous and good contact between the bows and the overhead wires, as any inequality which might momentarily throw off the leading strip would not, as a rule, affect the trailing one. At the same time the use of two strips naturally reduces the amount of current to be carried by either, and the use of the two ensures that no strip shall, under the worst conditions, have to collect more than 50 amperes, while the normal average is about 30 amperes. While it is probable that these arguments in favor of two strips are valid, it is a matter of interest that it is found that the bows will operate quite satisfactorily with the railing-strip removed.

The whole of the electrical apparatus for the coaches was built and supplied by the Allgemeine Elektricitäts Gesellschaft, of Berlin. This firm acted as main contractors for all electrical equipment on the South London line, and as main contractors for the electrical equipment of rolling-stock on the Crystal Palace extension. The general design of the coaches was worked out jointly by Mr. D. Earle Marsh, M. Inst. C. E., the locomotive superintendent of the railway, and Mr. Philip Dawson, the consulting engineer for the electrification.

ANNUAL CONVENTION, C. I. C. I. & C. F. ASSN.

A letter ballot has recently been taken among the members of the Chief Interchange Car Inspectors & Car Fmns. Association for the purpose of changing the date of the annual convention which had been set for August 20, 21 and 22, 1912. This vote favored the change and official notification is given by the secretary with the approval of the president and chairman of the board, that the annual convention will be held August 27, 28 and 29, at Chicago, Ill.



Pipe Rack, G. R. & I. Ry.

PIPE RACK.

The accompanying sketch shows a neat and substantial pipe rack in use at the shop of the Grand Rapids & Indiana Ry. at Grand Rapids, Mich. The uprights are formed of 2-in. gas pipe and the cross pieces of 1¼-in. pipe which provide adequate strength and stability. The sketch is self-explanatory.

BETTENDORF CALENDAR.

The Bettendorf Axle Co., Bettendorf, Ia., has distributed a most elaborate calendar for the year 1912. This calendar is meant to take the place of that issued for 1911 and is fitted with snaps and rings for suspension from the truck frame model. The familiar chart of dismounting operations is included as a part of the illustration.

RAILROADING AROUND THE WORLD.

By W. L. Saunders, Pres., Ingersoll-Rand Co.

A traveler who encircles the globe learns to appreciate the value of American railways. He also learns to prefer railway traveling, when long distances are concerned, to traveling in ships. One who visits Japan from the United States goes nearly half way around the globe, and if he is in a hurry to get home, appreciates comfort and likes to visit new scenes, he is better off coming home by way of Siberia, Germany, France and the Atlantic Ocean rather than to subject himself to the monotony of the broad Pacific. He may also save a few days, if he makes his connections.

The broad Pacific is interesting only in the contemplation of its expanse. No one can conceive of greater solitude than to be afloat on the Pacific Ocean. Its wave motion is usually moderate, with a broad expanse between the undulating crests. It is smooth on the surface and there are no signs of life, save an occasional flying fish, a rare encounter with porpoises and a whale now and then, whose antics are as welcome to the voyager as sunshine is to the Londoner in a November fog.

Recent railway construction and much improvement in equipment and operation add greatly to the comfort of the Trans-Siberian journey. Until recently one either crossed the Japan Sea, about a three days' journey, or took a more distant route to Port Arthur, and then made his way toward the Russian railways. But now it is simply necessary to travel by the Government railway of Japan to the extreme south of the Islands, Shimenoseki, then across the narrowest body of water in that section which separates the Continent from Japan. This is a one night trip only, in comfortable boats, landing one at Fusan, Korea. A word or two might be said of the railways in Japan. All the principal lines are owned by the Government, and this is always bad. It makes for inefficiency, bad management and lack of the best accommodations. Furthermore the railways in Japan are narrow gage roads, which seem to serve the purpose very well in a small country where the people are personally small in stature, and where furniture and accoutrements, such as we enjoy, are rare. These narrow gage railways are very well equipped for narrow gage railways. The trains go at considerable speeds and except in over night service one is reasonably comfortable.

The road from Fusan northward through the center of Korea is of broad gage with modified Pullman accommodations, under Japanese management, and an improvement on anything experienced in Japan. This road runs continuously through Seoul to Mukden, thence northward on the eastern Chinese Railway to the junction of the Trans-Siberian road at Harbin.

These railroads are patrolled by Japanese soldiers and operated by Japanese workmen. The soldiers do their duty in a manner above criticism, but it evident that the Japanese are not naturally mechanical and that operating railroads is a service of great difficulty to them. They have in Japan, for instance, copied American and European types of locomotives and so far as the reproduction is concerned it is perfect, but if anything goes wrong, if a connecting rod should work loose or a hot box trouble occur, the Japanese workman shows little initiative and skill. He is very apt to try the very same experiment he tried when a previous trouble arose, though the causes may be quite different. I have seen six or eight men puzzle for an hour or more over a simple case of hot box, trying all sorts of remedies and showing a lack of clear knowledge of the theory of the trouble. A Japanese mechanic laboriously learns to do a certain thing and when he masters it he can do that thing well, but if you shift him or introduce a new element in his work he is ill at ease. A simple illustration of this occurred on a Japanese railway where the clasp holding a lady's traveling bag was pulled out. Both the conductor and brakeman puzzled for at least twenty minutes in an effort to repair the damage, when the lady herself (a girl of twenty years of age) impatiently took the bag from their hands and fixed it.

The Trans-Siberian Railway runs from Vladivostok to Moscow, a journey of from eight to nine days. The equipment, especially on the International train which runs once a week, is first class, with comfortable cars and good food. In the extreme east coal is burned on the locomotives, but as one reaches the interior of Siberia, where wood is plentiful, the engines are all wood-burning. The gage of this railroad is five feet, which adds to the size and comfort of the cars. The staterooms are large,—some with two beds and others with four. These cars are all of the Russian type, the same as used on the Nord Express, which runs from St. Petersburg to Paris, and on the Orient Express from Paris to Constantinople. The speed averages a little more than twenty-five miles an hour, generally about thirty, and at times even faster. Stops at stations are not as infrequent as one would suppose, but occur in periods of two or three hours. The country itself is not a barren waste; there is no desert land in view, but it resembles Canada or a portion of the western United States. There are times that one would suppose the train was going through the Coeur d'Alenes in Idaho, or northward through the Cobalt District in Canada. The country is rolling, mountainous only around Lake Baikal and at the Urals there is much evidence of forests, burned for the purpose of clearing.

There is really less inconvenience, less friction and more real comfort of travel in a trip from Vladivostok to Moscow than from Paris to London. This statement is made deliberately by one who has had experience. Railway traveling becomes tiresome and excites one's nervous system in proportion as the trains wabble around curves, as the cars are crowded and as changes are required, while making a journey. This little trip from Paris to London involves all the difficulties of travel. The trains in France and in England are always crowded. There is a rush to look after one's baggage, the cars are light, the tracks laid in curves, the speed high, and one is apt to reach the end only to find it necessary to scramble on to a little bateau with few, if any, comforts, and a passage by water which is either rough or extremely dull. On landing the same experience is repeated.

One learns to appreciate the Pullman car, which through its heavy weight, wide berth and open construction is supreme over anything abroad. While the road beds of Europe are fairly good, little irregularities are more plainly felt through the light equipment used there, hence car sickness is more frequent. The dining car service is satisfactory only in that the food is good. There is little variety about it as it is table d'hote and is served in a perfunctory manner, with a rush and clatter of dishes exceeding anything experienced in an American diner.

ENGLISH SUPERHEATERS.

The greater attention given to British locomotives, with consequent economies in coal consumption ranging up to 20 per cent, has led to a great improvement and simplification of earlier designs. Foreign types of superheaters have been used, but there is said to be a growing disposition among British railway engineers to employ their own designs. The Robinson tube superheater, the invention of the chief mechanical engineer of the Great Central Co., has given satisfactory results. Although it has been in use for only a few months, nearly 200 Great Central engines already are being equipped with it. It is also being adopted by the Great Northern, North Eastern, Caledonian, South Eastern & Chatham, Tilbury, and other railway companies.—London Times.

FIRST AID ON THE LACKAWANNA.

As noted in our last issue, the Delaware, Lackawanna & Western R. R. is giving considerable attention to instructing its employes in giving first aid to the injured, with the hope that if any one is hurt on this line there will be some one nearby who is competent to render first aid. This work has been in progress at the Scranton and Hoboken shops longer than at other points, and at these places there are regular teams of five or six men each who are thoroughly instructed in the methods and who hold diplomas from the American Red Cross Society. Courses are also being given at Bangor, Binghamton, East Buffalo, Elmira, Gouldsboro, Kingston, Oswego, Stroudsburg, Syracuse, Utica and Washington. The first aid packets which are distributed in and about all stations, yards, trains and shops are placed in a sealed cardboard box about 3x5 inches in size and contain one-half yard of plain gauze compress, one plain gauze bandage ½ in. x 3 yds., and one printed triangular bandage with safety pins. Conductors, station agents, yardmasters and foremen are required to have at least two of these packets in their possession while on duty. An index card, shown in the illustration, is included in the packet, and when the contents are used the card is filled out and sent to the superintendent, who files the data and who in turn mails it to the chief surgeon. At a number of the more important points there are large tin boxes filled with supplies and materials enough to provide for a large number of people, in case of a train wreck or a similar accident. A course covering a series of three lessons is given on certain evenings and records are kept of those attending. Lectures and demonstrations on a living model are given in the shops once a month and the photographic reproduction shows first aid instruction being given by Dr. Shields of the American Red Cross at the Scranton shops.

INDEX CARD

Station_____ Date_____

Name of Injured Person_____

Passenger Employe Trespasser

Address_____

Cause of Accident_____

Nature of Injury_____

Final Disposition of Injured Person_____

(Send this card to Superintendent, who will furnish new packet.)

Signed_____

(See Other Side)

Position_____

Index Card for First Aid Packets.

ELECTRIFICATION OF THE B. A. & P. RY.

The electrification of the Butte, Anaconda & Pacific Ry. has been started and the work is to be pushed as fast as possible, with the expectation of completing it within a year. The road operates through the mining district between Butte and Anaconda, Mont., and handles a large amount of ore traffic. It has at present 27 steam locomotives and the length of single track to be electrified is about 95 miles. The electrical equipment is being furnished by the General Electric Co. and the installation will be notable in that the locomotives will operate on 2,400 volt direct-current circuit. Fifteen 75-ton electric locomotives for freight service will be furnished, each equipped with four G. E. 1,200 volt motors connected in series for 2,400 volts, and the control will be of the Sprague, non-automatic, type M, being arranged for double end operation. The air brakes will be of the straight and automatic type and will be operated at 600 volts, the compressors being operated from the dynamotor. Two 2,400 volt passenger locomotives are to be furnished, which will be the same as the freight locomotives except for higher gearing. Power will be furnished by the Butte Electric & Power Co. at 2,300 volts, 3 phase and 60 cycles. There will be two sub-stations located 26 miles apart, each equipped with two 1,000 K. W., 2,400 volt synchronous motor-generator sets. Overhead trolley construction of the catenary type will be used.

First Aid Class at Scranton Locomotive Shops, D., L. & W. R. R.

BALANCED COMPOUND FREIGHT LOCOMOTIVE, BAVARIAN STATE RYS.

One of the most interesting of the locomotives shown at the Turin Exhibition, according to *The Engineer*, is an entirely new type of goods engine, with ten wheels coupled, built by J. A. Maffei, of Munich, for the Bavarian State Railway. Most of the locomotives exhibited embody nothing novel in their cylinder arrangement or their motion. For the most part they have the cylinder arrangement and rocker arm transmission for one pair of valves introduced by the late Mr. Webb in his four-cylinder compound type. This system of rocker arm in front of the cylinder is now considered a first-class arrangement for simple engines, as it saves two valve gears. At Turin, the only locomotives not so fitted are the complicated French engines and the Bavarian engines now under consideration. In 1889, Mr. de Glehn, some years prior to Webb, proposed to use rocking arms as a simplification on the Nord compound locomotives, but these, being rejected, led to the complicated engine with one complete valve gear for every cylinder, now the standard practice in France.

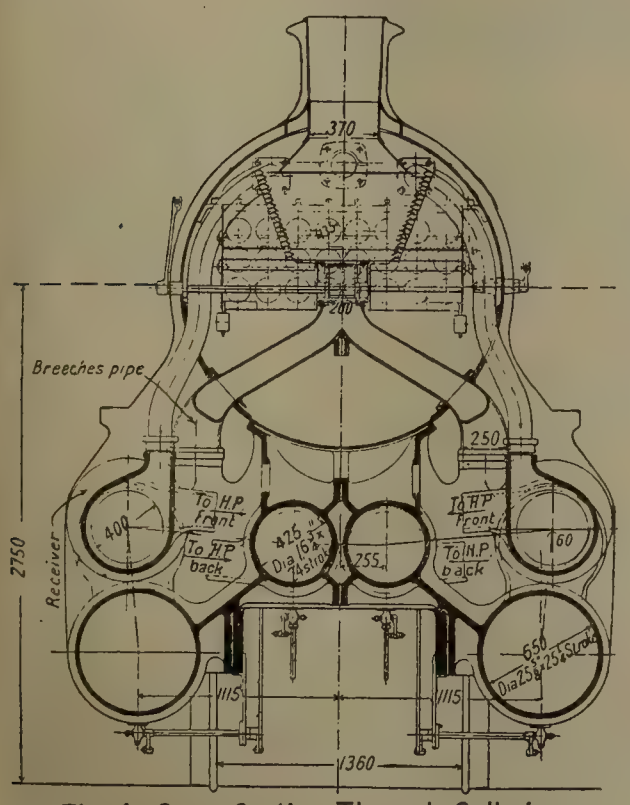


Fig. 1—Cross Section Through Cylinders.

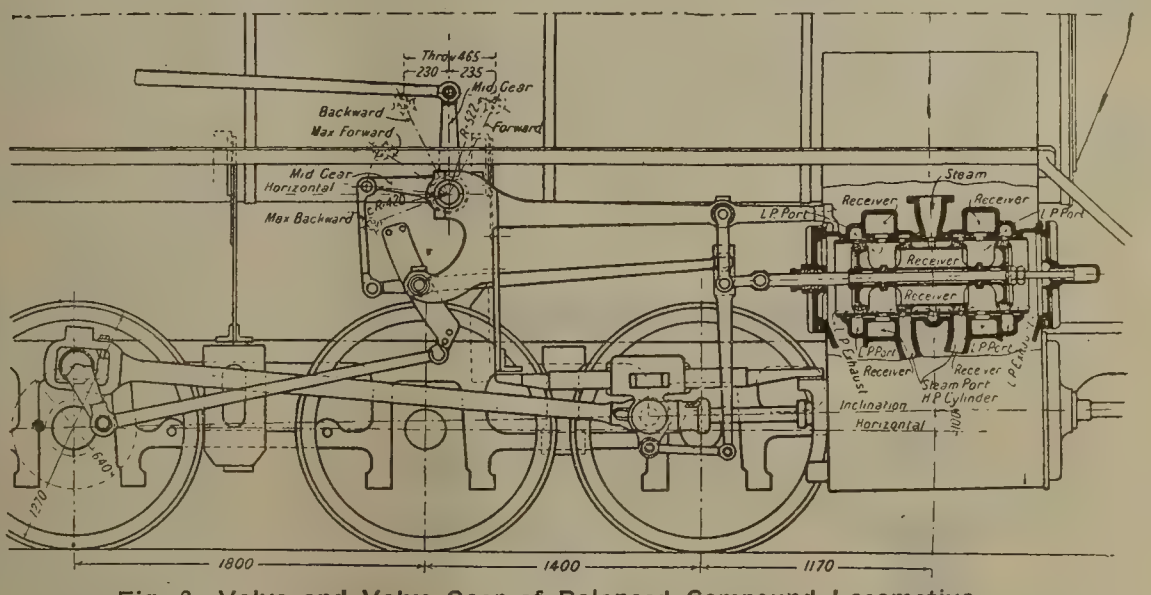


Fig. 3—Valve and Valve Gear of Balanced Compound Locomotive.

In the new Bavarian engine these rockers are avoided altogether, and a valve distributing steam simultaneously to two cylinders is employed instead. This of itself is not a novelty, previous applications of the principal having been made by du Bousquet in 1888 and by Vauclain in 1902, while in 1899 Plancher combined the double valve with a receiver. In the new Maffei design, however, a voluminous receiver is neatly contrived within the space embraced by the two heads of the piston valve, and in this we have a distinct novelty. To secure this result, annular steam receivers are formed around the barrel of the valve chest. These receivers are always in communication with the interior of the piston valve, and, in addition, with the high pressure exhaust whenever this is opened by the valve.

The two annular receivers are in intercommunication through a $2\frac{5}{16}$-in. pipe, thus assuring equality of steam pressure in the two low-pressure cylinders. The volume of each receiver being approximately that of the high-pressure cylinder, their combined volumes are equal therefore to twice that of one high-pressure cylinder—a somewhat low proportion, but in this case the piston speeds are not very high, and the steam is superheated.

With this arrangement no receiver pipes are required. In simple engines with four cylinders there are either four steam pipes, or else forked pipes equivalent thereto; in either case a complicated steam piping arrangement in the smoke-box is involved. Two simple steam pipes suffice, however, with the new valve. The simplicity realized is considerable. Mechanically there is a gain represented by the reduction of four valve motions and valves to two. Not only does this save in the matter of first cost, but obviously there is a saving due to the reduction in the weight and frictional resistance of the moving parts. Again, receiver pipes are done away with, and the parts in the smoke-box are reduced. Thermally, the arrangement steams-jackets part of the valve chest and the interior of the valve itself, the steam pressure that is constantly maintained therein being from one-fourth to one-third of the initial pressure of the first expansion. For example, with saturated steam having an initial pressure of 160 lb. the average back pressure in the small cylinder —say 45 lb., or 293 deg. Fahr.—will be the average pressure maintained in the annular receiver and in the interior of the piston valve; and when this valve opens to the low-pressure steam ports the initial cylinder pressure therein will be between 45 and 40 lb., or about 290 deg. Fahr. The drop in pressure and temperature is thus very minute, and a practically continuous expansion is the result. From a fitter's standpoint the single outside valve—there is no valve motion of any sort whatever in between the frames—is said to be found remarkably easy of access for inspection, erection, or taking down.

Figure 3 shows the construction of the valve and gear; while the distribution of the steam passing through the valve is shown diagrammatically in Figure 4. In the latter engraving the valve is represented as being much smaller than the cylinders. In reality the valves are $15\frac{3}{4}$ ins. diameter, and the high-pressure cylinders $16\frac{3}{4}$ ins. Excellent results are said to be obtained by the use of very large piston valves, and there is a general tendency further to increase the dimensions of such valves in common with a radical amplification of the ports and pipes leading to the blast. In Austrian locomotives valves $18\frac{1}{4}$ ins. diameter are used for $17\frac{7}{8}$ ins. diameter cylinders. The smoke-box cross section brings out the true proportion of the parts as adopted on the Bavarian Railways.

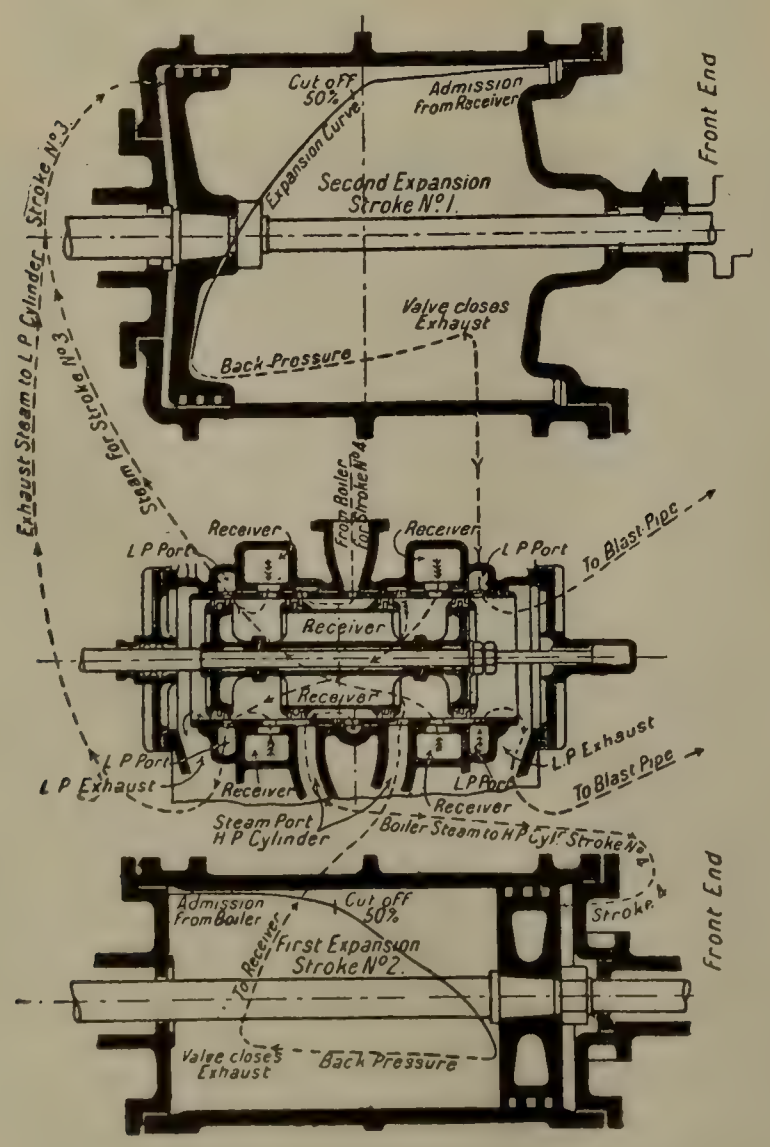
The back pressure of the final exhaust is reduced by providing a voluminous exhaust pipe at each extremity of the valve chest. These pipes unite just under the smoke-box, and their common exit is connected to one limb of the internal branched exhaust pipe.

Such details as those described above have been proved by numerous experiments in recent years to be of the utmost importance as regards both the efficiency and the speed of the engine. With the progressive increase in the size of boilers all the steamways to, and above all from, the cylin-

ders have undergone a continuous amplification. This is notably so in the case of the valve chests, the steam and exhaust ports, the clearance volumes, the lead to exhaust on the valves, the blast pipes and blast nozzles, etc. The engravings accompanying this article show the ample, short and straight steam outlets typical of modern locomotives. The proportions, as seen from the cross section, appear quite abnormal relatively to less advanced engine designs. On the other hand, the chimney sectional area is small, this circumstance being necessary with superheated steam in order to maintain an adequate smoke-box vacuum. A protective casing for the hot chimney conceals externally its slender proportions.

The adoption of the balanced compound system for freight engines is quite an innovation in Bavaria, where, until now, they have been built for simple expansion. Following the example of other European railways, the Bavarian State, which has for years employed the compound system exclusively for all its express passenger engines, has not considered the question of steam economy to be so important in goods engines. Indeed, statistics show the gain directly due to double expansion to be less in the course of a year with goods engines than with high-speed engines—and this for various well-known reasons.

The new engines will directly succeed certain simple-expansion engines of the 2-8 wheel type, known as class 4000, and having outside cylinders 21¼ ins. in diameter by 22 ins. stroke. To surpass the power of these simple engines without exceeding the gauge limits necessitated the introduction of multiple cylinders; and, given four cylinders, there was nothing to gain, but considerable to lose, from the continuance of simple expansion. Mechanically, no four-cylinder non-compound locomotive yet designed has been made so effectively simple as the compound engine now under notice.



——— Expansion curves.
. . . . . Events to follow.

Fig. 4—Distribution Diagram.

It should be noticed, however, that with equal pressures of saturated steam in both the old and new Bavarian freight engines, the increase of cylinder power is not so great as would appear to be the case judging merely from the combined volumes of the four cylinders. In the first place, the high-pressure cylinders in the new engines are 28 per cent less voluminous than the cylinders of the simple engine. Secondly, a deduction of about 25 per cent from the full power of the smaller must be made if the second expansion is to develop the same horse power as the first expansion. With these allowances the effective power of the first expansion of the compound is much less than in the simple engine, as shown by the following statement, in which the unit of volume multiplied by pressure in the simple engine is taken at 100:

	Simple Class 4000.	Compound Class 5800.
Volume × pressure of one cylinder.....	100	72
Back pressure, 5 per cent simple, 25 per cent compound	5	18
Effective volume × pressure.....	95	54

The full compound expansion is thus: H. P. 54 + L. P. $\frac{108-95}{108}$ = 12 54 = 108, representing an increase of only per cent in power over class 4000. The steam consumption, estimated from the longest running cut-off — 50 per cent simple expansion and 60 per cent compound expansion — is 0.50 × 100 = 50 for the simple and 0.60 × 72 = 43.2 for the compound. This shows a difference in favor of the compound of 13 per cent while developing 12 per cent more power, or otherwise the compound develops 25 per cent more power on a given steam consumption.

In the engines of class 5800, the power is further increased by employing a very high steam pressure, 227 lbs. per square inch. The boiler capacity is increased by superheating the steam to about 650 deg. Fahr. and augmenting its volume correspondingly without that increase in fuel consumption which the generation of a like volume of saturated steam would entail. Using this steam, the high-pressure cylinders are made rather larger in volume than would be those designed to develop the same power with saturated steam at the same cut-off. This has decreased the ration of cylinder volumes to only 1:2.45, or the correct proportion for economical results with saturated steam at 174 lbs. pressure. It will be observed that the disposition of the cylinders and valves, clear above the frames, allows the greatest freedom in designing the cylinders. Hitherto Bavarian practice has favored the casting of the group of cylinders in three pieces; in this case there is a return to the American arrangement of two-piece castings bolted together at the middle line of the smoke-box saddle. For the conservation of the heat in the steam the whole design of the cylinders and their short transverse steam connections appears admirable.

Bar frames, milled on both sides, are employed, but the front ends are forged out in the form of slabs. The whole of the machinery of the engine, from the cylinders to the crank axle, is simultaneously visible to anyone standing on the ground under the running boards; even the rods and cranks right out on the opposite side of the engine are partially visible from the same standpoint. This ease of inspection and attendance is particularly remarkable. The exceptional lightness of the frame enables the makers to build powerful engines for light roads which forbid the use of heavy locomotives.

The new freight engines are required to maintain a speed of 15 to 16 miles per hour when ascending gradients of 1 in 100 to 1 in 90 of 30 miles in length with numerous curves,

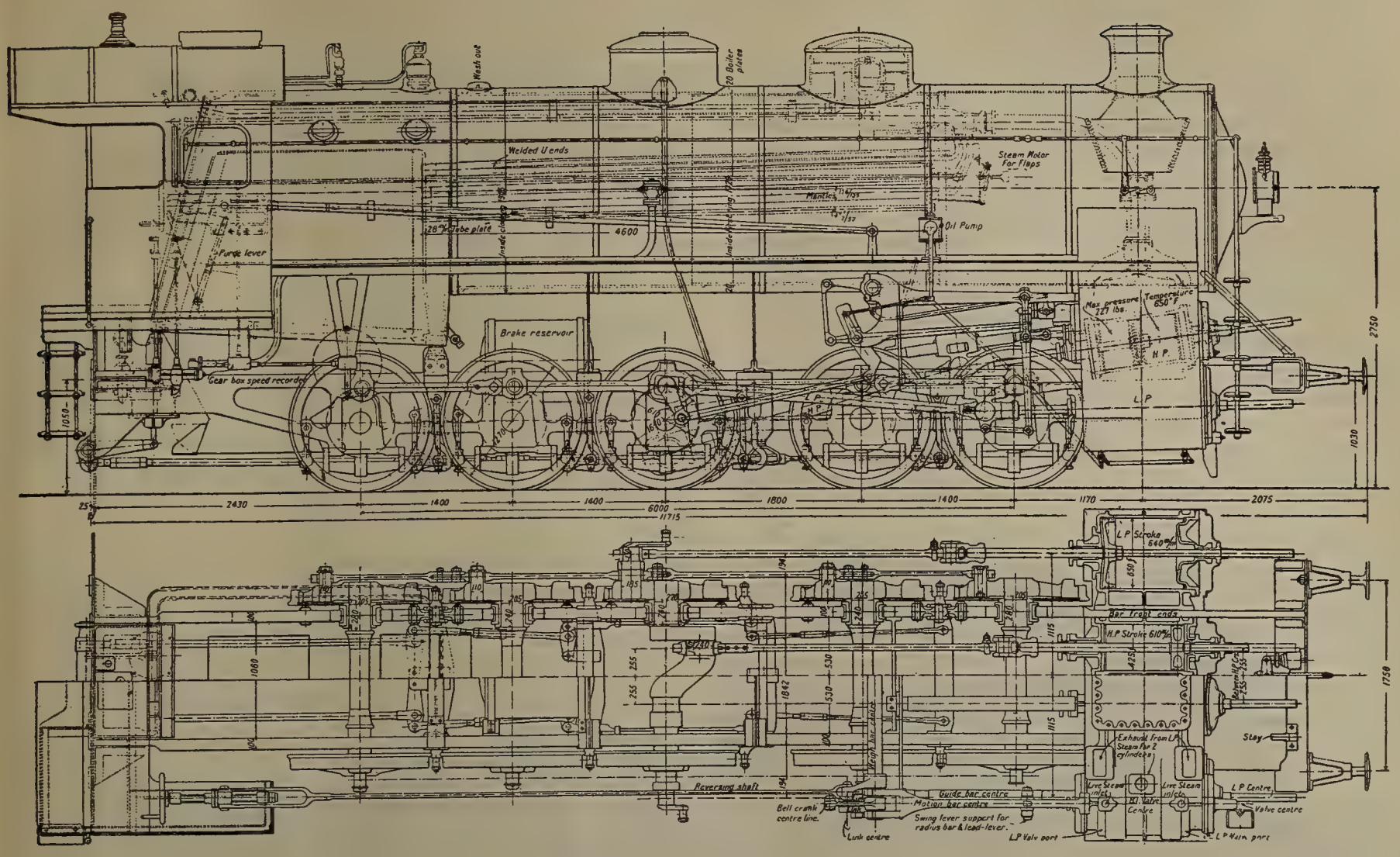


Fig. 2—Balanced Compound Locomotive, Bavarian State Rys.

and while drawing a car load of 800 tons, or 928 tons with engine and tender fully loaded. The tractive effort under these circumstances is about 13 tons, and for this an adhesion weight of 77.5 tons maximum is provided. The revolving masses are very nearly perfectly balanced, and this enables the engines to run very smoothly at speeds up to 37 miles per hour with heavier trains on the level sections. To facilitate the taking of curves, the first and fifth axles are allowed a certain amount of play in their axle-boxes and side rods, while the third pair of wheels has its flanges turned thinner than the rest. For the even distribution of the weight the first and second and fourth and fifth pairs of axle springs are equalized with balance levers.

The specimen engine exhibited at Turin was noticeable for the severity of its finish, the dull lead color contrasting with the brilliant color and varnish of all other locomotives save the Swiss. The effect of this was to divert one's attention from the boiler exclusively to the machinery, of which more was visible to the passerby than in any other locomotive exhibited.

Table of Dimensions.

Steam temperature	About 650 deg. Fahr.
Test pressure	228 lbs. per square inch.
Cylinders, H. P., diameter	16¾ ins.
Cylinders, H. P., stroke	24 ins.
Cylinders, L. P., diameter	25⅝ ins.
Cylinders, L. P., stroke	25 15/16 ins.
Driving wheels, diameter	4 ft. 2 in.
Heating surfaces, water	2,217.45 sq. ft.
Heating surfaces, steam	508.07 sq. ft.
Heating surfaces, total	2,725.52 sq. ft.
Grate area	38.83 sq. ft.
Weight, empty	69.5 tons.
Weight, fully loaded	77.5 tons.
Total wheel base	19 ft. 8 in.
Rigid wheel base	10 ft. 6 in.

GENERAL FOREMEN'S ASSOCIATION.

The General Foremen's Association will held its next annual convention in Chicago, at the Hotel Sherman, July 23 to 26, 1912, inclusive, with the following papers as subjects:

No. 1—How Can Shop Foremen Best Promote Efficiency, continuation paper No. 1 of 1910 convention, by Wm. G. Reyer, general foreman, N. C. & St. L., Nashville, Tenn.

No. 2—Shop Supervision and Local Condition, W. W. Scott, superintendent shops, P. M., Saginaw, Mich.

No. 3—Shop Specialization Work and Tools, W. T. Gale, demonstrator, C. & N. W., Chicago.

No. 4—Round House Efficiency, Wm. Hall, general foreman, C. & N. W. Ry., Escanaba, Mich.

Special Paper No. 1—Re-claiming of Scrap, by C. H. Voges, general foreman, Big Four, Bellefontaine, O., and C. Ogden, general foreman, A. T. & S. F., Las Vegas, N. M.

Special Paper No. 2—The Relation of Tests to Shop Efficiency, by J. S. Sheafe, engineer of tests, and L. A. North, general foreman, Illinois Central, Chicago.

A novel fluid motor has been invented by John A. Van Deventer, of the Buffalo Forge Co. It consists essentially of two herringbone gears rolling together in a casing and is called the "Spiro" motor. The casing follows the curvature of the gear closely up to the point of contact, at which place steam or some other fluid is introduced through an opening, as the gears roll toward it. The steam enters at the center of the gear where the opposing curvatures meet and the width of the opening at the center determines the cut-off of the engine. After cut-off the steam continues to expand as the V shaped tooth grooves continue to roll apart and when these grooves have rolled around so that the teeth in the other gear no longer close them the steam exhausts. The difference in pressure between the grooves is slight, so there is practically no leakage between them and the casing. There is also a decrease in friction.

PETROL-ELECTRIC MOTOR CAR, GREAT WESTERN RY.

By Thos. Reece.

One of the first decisive steps in what will probably prove to be a new phase in railway traction in England was taken by the Great Western Railway recently when a petrol-electric railway car built by the British Thompson-Houston Company was run from Leamington to Slough. The photographs give an idea of the external and internal appearance of this car.

The car has been produced by the British Thompson-Houston Company to the united design of its own staff and the Great Western officials, the latter having, at the instigation of the late general manager, made the new system a matter for study, until the present vehicle has been evolved.

Although, with one exception, the system has not been previously tried for railway purposes in this country, it is in common use on the continent, being, in fact, on one railway system in Hungary practically the only tractive power in use, and has also been the subject of experiments in road buses.

Petrol-Electric Car for Great Western Ry. (England).

The car which has just been received by the Great Western Railway was built for experimental purposes, and weighs only 31,360 lbs. The power is supplied by a 40 H. P. Maudslay petrol engine, which drives a dynamo, which in turn, transmits power to two electric motors on the axles of the rail car.

Notwithstanding the light weight of the vehicle, it accommodates 44 passengers, and this in itself is one large advantage of the petrol-electric system, the weight of the car, engine, dynamo, etc., per passenger, working out to only 700 pounds as compared with about 1,512 pounds for the steam rail cars in use on the Great Western.

A further advantage is that the fuel is contained in a very small area, the petrol tank, which is carried underneath the experimental car, holding sufficient petrol for between 200 and 250 miles running.

The car is divided into three compartments:

(1) Containing petrol engine, dynamo and controller.

(2) Passenger compartment.

(3) Conductor's compartment, also containing electrical controller and brake control, the car being driven from either end, according to requirements.

Only one man is required at the driving end, the conductor riding at the opposite end, and attending to the engine if required, he also being in a position to stop the car in case of emergency.

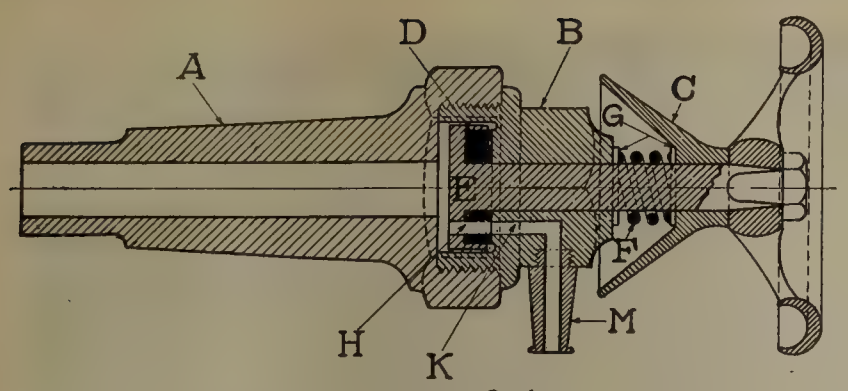
The new system should prove, for the above reasons alone, in the case of small cars, considerably more economical than steam power, and with these advantages the further development of certain sections of the line which have hitherto not presented the likelihood of paying loads, should be possible.

The car is at present running between Slough and Windsor completing a series of tests.

BAXTER GAUGE COCK.

The question of gauge cocks is one that has received much attention by some railroads, and is always a subject of much interest, especially where power is operated in districts with bad scale forming water. The Illinois Central R. R. has on trial a new gauge cock, which has so far proven most satisfactory. It is the invention of W. M. Baxter, general mechanical inspector of the road. The salient features claimed for it are its extreme simplicity of construction, low cost of maintenance, and absolute tightness in both steam and water. It is self grinding, non-packed, scale freeing, and the seat may be blown off under pressure. There are no threads on the valve stem to be stripped by misusage.

Referring to the illustration, the construction is as follows: The body A has screwed into it a bonnet B which contains a rotary valve E having a composition seat D in which are three equally spaced ports, one of which is seamed at H registering with an outlet K to the tit M. This valve is held on its seat in the bonnet B by boiler pressure exerted against the rotary E. This composition seat becomes soft enough under temperature to conform to any unevenness which may exist on the brass seat of the bonnet B. This insures a tight fit at all times. When there is no pressure on the boiler the spring F holds the seat tight in order to prevent the water in the boiler from trickling out at M. If it is desired to blow the seat off under pressure all that is necessary is to force the valve in with the hand compressing the spring G. This separates the seats and steam and water pass over their surfaces, washing them free of any scale or grit. The guard C is placed on the valve stem to protect the hand during this



Baxter Gauge Cock.

process, as some steam escapes around the stem when the valve is off its seat. In repairing this gauge cock, the body A of the valve remains in the boiler, and only the bonnet B is removed, as this contains the valve itself. This makes it possible to maintain a standard size of gauge cock tap for all locomotives on the system as the body of the cock is not removed, and the hole is therefore not tapped out to larger sizes, in order to effect a tight joint when the gauge cock is replaced in the boiler head. The only part that will wear much is the composition seat D; these will ordinarily last six months and will cost 6½ cents each. They can be readily replaced in ten minutes' time by removing the bonnet and hand wheel. The valve stem is then removed and the old seat taken out and a new one applied. All this can be done by unskilled labor, as there are no delicate parts to be ground into a steam joint. The ports in the rotary will not scale or plug up as the valve is always immersed in water or steam, therefore, any scale forming precipitate which may lodge in them will remain plastic, and be blown out when the valve is operated.

EDUCATIONAL BUREAU, C. OF G. RY.

The Central of Georgia Ry. on March 1, 1912, established an educational bureau for the benefit of its employes. The educational work is to be identical with that on the Union Pacific and the Illinois Central railroads. D. C. Boy, a special representative of the educational system now in vogue on the Union Pacific and Illinois Central lines, is in Savannah mapping out the preliminary work incident to the organization of the new department. Mr. Boy, for the present, will have charge of this work on the Central of Georgia.

An educational system is the latest step taken by the Central of Georgia to promote the efficiency of its employes, and eventually the improvement of its service. This new department should at once appeal to the ambitious employe because it affords him an excellent opportunity to better himself. The educational plan is in line with the road's progressive policies, which are being applied by its present management.

Thomas Beaghen, Jr., has been appointed master car builder of the Union Tank Line, with office at New York.

Interior of Petrol-Electric Car.

Car Shops of the Hocking Valley Railway

By C. A. Tupper.

For a number of years the Hocking Valley Railway Company did practically all its car repair work in its South Columbus shops; but the facilities there were inadequate for the constantly increasing demand for work of this character and, after a careful consideration of the various details involving the location of a plant to effect economical operations and accomplish the greatest efficiency, a plant modern in every respect was built at Logan, Ohio. This town represents the most advantageous distributing point for the equipment, inasmuch as it is the central station for the four divisions of the Hocking Valley Railway and is also the distributing point for coal cars, which represent 80 per cent of the company's business. The heavy coal tonnage necessarily made repairs for the coal carrying equipment a large item, but with the shops at Logan the Company effects a considerable saving in the transportation of cars; and, further the fact that the cars can be taken directly from the shop and distributed to the various coal properties was another factor in deciding on this location. After determining upon the site, the officials of the Hocking Valley Railway made a careful inspection of the most modern practice in the United States, with a view to building a plant not to be surpassed in design and equipment.

The works consist of eight buildings of brick and steel construction, as follows:

Car repair and assembly shop, saw shop, office and store room; blacksmith shop; wheel, axle and air brake shop; lumber storage building; power house and oil house.

These are concentrated along a traveling crane runway, which serves all of the main buildings beginning with the saw shop buildings or mill, main repair or erecting shop, blacksmith shop, store room and material platforms. This crane runway is 600 feet long, and the traveling crane which runs upon it is capable of lifting a load of five tons.

Saw Shop Showing Individual Motor Drive on Rip Saw and Cut-Off Saw.

Saw Shop.

At the southeast end of the crane runway is located the saw shop or mill. This structure, 200 feet long, 70 feet wide, is built of paving brick on concrete foundations, and as much of the walls is given to windows as is consistent with strength. The roof, supported by steel trusses, is equipped with eighteen large sky-lights glazed with wire inserted glass. A monitor runs the length of the roof, also to give light and ventilation. Inasmuch as by far the largest percentage of repair work done is on the wooden coal cars, naturally the greatest amount of power utilized is in the saw shop.

In this building all the lumber used in the reconstruction of the cars is worked into the necessary shapes and sizes. To accomplish this the shop is equipped with a swing cut off saw, tenoner, two boring machines, gainer, crosscut saw, timber planer and matcher, rip and band saws, together with the necessary grinding machines. These tools are all connected to 60 cycle, 3 phase, induction motors, fifteen motors in all being employed in this capacity as follows:

One cut-off saw belted to a 15-h. p. 1130 r. p. m. motor.

One timber sizer direct connected to 50-h. p. 900 r. p. m. motor.

One swing saw belted to a 5-h. p. 1130 r. p. m. motor.

One tenoning machine belted to a 15-h. p. 1130 r. p. m. motor.

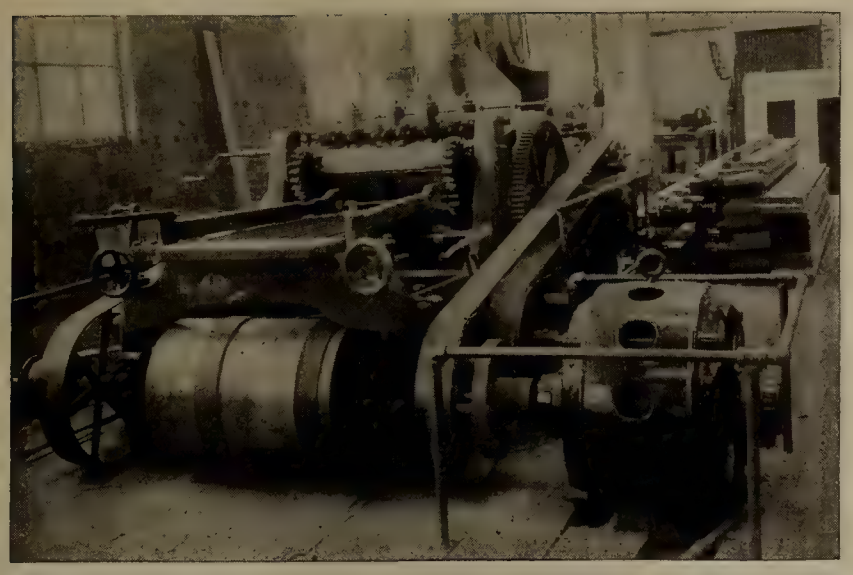
One mortizer belted to 15-h. p. 1130 r. p. m. motor.

One rip saw, one gainer, one wood worker and one tenoner grouped on a 15-h. p. 1130 r. p. m. motor.

One self feed rip saw belted to 15-h. p. 1130 r. p. m. motor.

One gaining machine belted to 15-h. p. 1130 r. p. m. motor.

Two three-spindle boring machines, one single band saw, one automatic knife grinder belted in group to 20-h. p. 1130 r. p. m. motor.



50 H. P. Allis-Chalmers Motor Direct-Connected to Timber Sizer.

One planer and matcher direct connected to a 50-h. p. 900 r. p. m. motor.

One gainer belted to 15-h. p. 1130 r. p. m. motor.

One gainer belted to a 10-h. p. 1130 r. p. m. motor.

One three-spindle boring machine belted to 10-h. p. 1130 r. p. m. motor.

All of the motors, as well as the power house machinery, were supplied by Allis-Chalmers Co., of Milwaukee, Wis.

The arrangement of this machinery leaves practically nothing to be desired and was greatly facilitated by application of the electric drive. The timber is received in the rough at the east end of the shop and delivered in a finished condition at the west end ready to go to the dry lumber shed, which is located some distance west of this shop, or to the main car repair shop, which is located just north.

An extensive dust conveying system has been installed throughout the shop. To each machine is attached a receiver, into which the shavings, dust, etc., are drawn by a fan belted to a 40-h. p. motor located on the roof trusses. All the dust is then transmitted in the usual way back to the boiler room and fed into the ovens as fuel. At the end of the saw shop is located a relay fan to help in the transmission, being driven by a 50-h. p. motor. The building is well lighted with arc lamps and each machine has one or more incandescent lamps.

Power House.

The power house is 94 feet by 40 feet and is located in such a manner that extensions can be made without interfering with the track layout and, therefore, additional equipment can be installed at any time. The power equipment consists of two 200-kw. 60 cycle, 3 phase, alternating current generators, direct connected to engines. The exciters are driven directly from the fly wheels of the engines, as shown in the illustration. In the engine room is also installed one compound steam driven air compressor to supply necessary air for the pneumatic tools, painting machines, etc.

The switchboard consists of five panels; two generators, one exciter and two feeder panels. The power load for each shop is controlled directly from the power house, as is also the lighting.

Induction Motor Driving 3-Spindle Boring Machine.

Boiler Room.

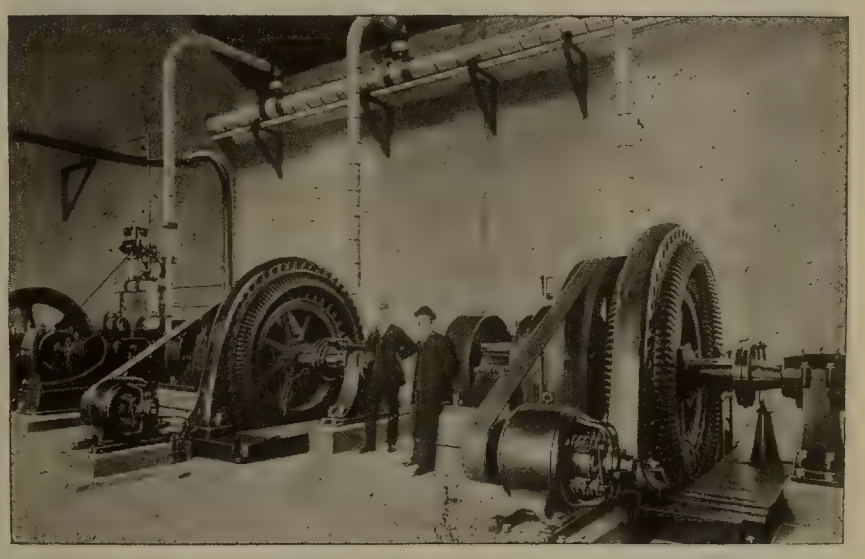
The boiler room equipment consists of three 200-h. p. water tube boilers furnished with Jones underfeed stokers, and the boilers are equipped with forced draft, the fan of which is steam driven.

Oil Storage.

In a small isolated building adjacent to the power house is the oil storage house, which is 20 by 40 ft. This building is equipped with automatic oil feeders and contains all the inflammable material, as also all the paints, etc., used.

Round House.

The round house located along the right of way has a small auxiliary machine shop, which is driven by a 15-h. p. belted type motor. The round house was for a time equipped with its own boiler and engine plant as the water storage tanks are also located at this point; however, this plant has since been discontinued and the pump is now driven by a 15-h. p. direct-connected motor.



Power House Equipped with Allis-Chalmers Machinery.

Wheel, Axle and Air Brake Shop.

The designation, wheel, axle and air brake shop, signifies the nature of the repairs carried on in this building. It is 90 ft. long and 50 ft. wide and is characteristic of the other buildings in respect to light, ventilation and heating. Four motors, aggregating 92½-h. p., drive the various machines installed in this shop.

The equipment consists of one hydraulic wheel press driven by a 7½-h. p. geared motor, which is mounted on the top of the press.

On axle lathe, one boring mill and one small pipe cutting machine are driven in group from a 40-h. p. 900 r. p. m. motor.

One vertical drill press and one double end emery grinder are driven in group from a 5-h. p. 1130 r. p. m. motor.

Car Assembling and Repair Shop.

The car assembling and repair shop which is 500 ft. long and 160 ft. wide, is so located that the material from all the other buildings naturally gravitates to this section of the works. It is of steel construction with a tar and gravel roof. The sides of the building are sheathed with corrugated iron and are so designed that every other panel is a roller door or a window. In the summer the windows may be opened and the doors rolled up so that practically the sides of the building are opened. The natural lighting

of the building is increased by wire inserted glass skylights and a monitor running the full length of the building, the windows of which for ventilating purposes are regulated by a system of levers.

The building contains three ten-ton cranes to assist in the erection work. In front of the building and under a canopy is located a ten-ton crane which is free to travel in front of the blacksmith shop and the saw shop and convey the heavier parts to the car assembling shop. It is also arranged to take care of the wheels and axles after they come from the wheel shop. The car shop has a capacity of seventy cars, distributed on six tracks running longitudinally. There are also four larry tracks, on which push cars may be operated to increase the facilities for handling material.

The heating system of this building includes two blowers, each driven by belting from 50-h. p. motor.

Blacksmith Shop, Hocking Valley Shops.

Blacksmith Shop.

The blacksmith shop, 160 ft. long and 70 ft. wide, is similar in design and construction to the saw shop. All machines in this building are arranged in groups, as much as possible, and driven from line shaft. There are eight heavy forges installed, the air for which is supplied by a fan belted to a 40-h. p. motor. One combination punch and shear and a bulldozer are driven in a group from a 30-h. p. 900 R. P. M. motor. One double emery wheel, one grinder, one two-drill press and other light tools are driven in a group from a 15-h. p. 1130 R. P. M. motor.

Three triple bolt threaders, one punch, and one emery grinder, one "I" bending machine, one 7½-inch bolt header and one guillotine shears are driven in a group by a 30-h. p. motor. All these motors are mounted on the walls of this shop, about six feet above the floor line, so they consume practically no space and are not high enough to be injured by the smoke and dirt, which naturally exist in such a shop.

The blower heating system for the shop is driven from a 15-h. p. motor.

Motors.

Induction motors are, in all respects, the best type of machine for general power distribution on alternating current circuits, and they have special advantages for operation in plants of this kind, having no moving electrical contacts and consequently causing no fire risk. They also start under load, run at approximately constant speed regardless of load, and if the load is suddenly thrown off no racing can occur. They are extremely simple in construction, having no commutator or brushes, and this, as above intimated, insures absolute freedom from sparking, flashing or burning. The voltage in the rotating part is so low that insulation breakdowns do not occur. Furthermore, an induction motor, when started, does not require synchronizing and, on account of its simple construction and absence of all auxiliary devices, except starters, the cost of maintenance and attendance is less than for any other type of electric motor.

There are installed in this plant twenty-three constant speed induction motors with a combined capacity of six hundred and three horsepower, not including the three ten-ton cranes, which are each equipped with 35 rated horsepower.

The Webster vacuum heating system is installed in the entire plant.

The Logan shops of the Hocking Valley Railway represent an investment of $350,000 approximately, but it will readily be realized that the company has improved its service to a far greater degree than that shown by these figures. The shops will employ 450 men and will turn out 5000 heavy repair cars each year. They were originally designed to take care of 50% in excess of their present requirement, and, while they were built primarily as repair shops for wooden cars, they are also laid out with a view to taking care of the steel construction work later on.

The information and illustrations for this article were secured by courtesy of the Allis-Chalmers Co.

It is reported that the New Iberia, Lafayette & Northeastern is planning building from Eunice, La., southeast via Church Point, Lafayette and St. Martinsville, to New Iberia, about 60 miles. F. N. Welch, president; H. A. Genung, chief engineer, New Iberia.

INGENIOUS OVERSPEED LIMIT DEVICE.

A new overspeed limit device for rotary converters and motor-generator sets has been developed and will be furnished on all Westinghouse rotary converters built in the future, and, when especially ordererd, on motor generators. One of the illustrations shows the application of the new device to the end of a rotary converter shaft and the drawing illustrates the details. Advantageous features of the new device may be enumerated as follows: (1) Positive action, (2) few parts, (3) rugged construction, (4) compactness.

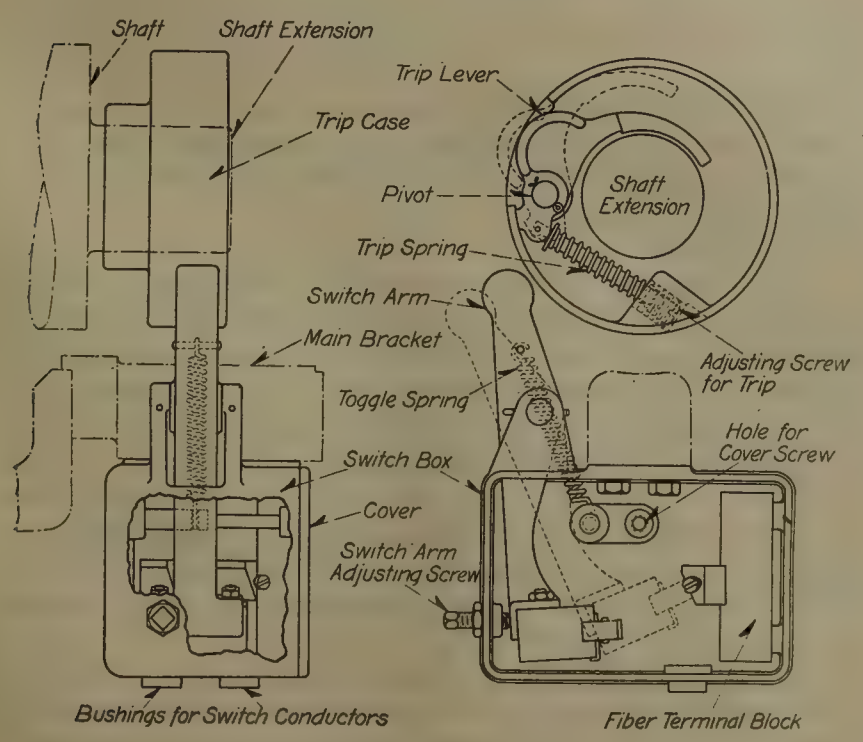
The operation of the mechanism will be apparent from a study of the drawing. Normally, the trip lever is held in the position shown in full lines by the trip-spring. If the speed of the machine exceeds the value (usually 15 per cent overspeed) for which the device is set, the trip lever, due to its centrifugal force, flies outward positively and quickly, and, knocking over the switch arm, closes the switch. A most interesting and important point in connection with its action is its positiveness. If the trip lever starts to fly out, the speed remaining constant or increasing, it will continue until it strikes the stop. This action is due to the proportions and disposition of the trip spring and the trip lever.

The point on the trip lever that strikes the switch arm is, approximately, at the center of percussion of the lever, a fact which insures an effective blow being struck by the lever. Normally the switch arm is held in the open position by a toggle spring. The relation of the spring to the lever is such that the resisting torque of the spring is a minimum. When the trip lever strikes the switch arm it forces the arm past the center point of the toggle mechanism and the switch, under the spring's tension, closes of itself.

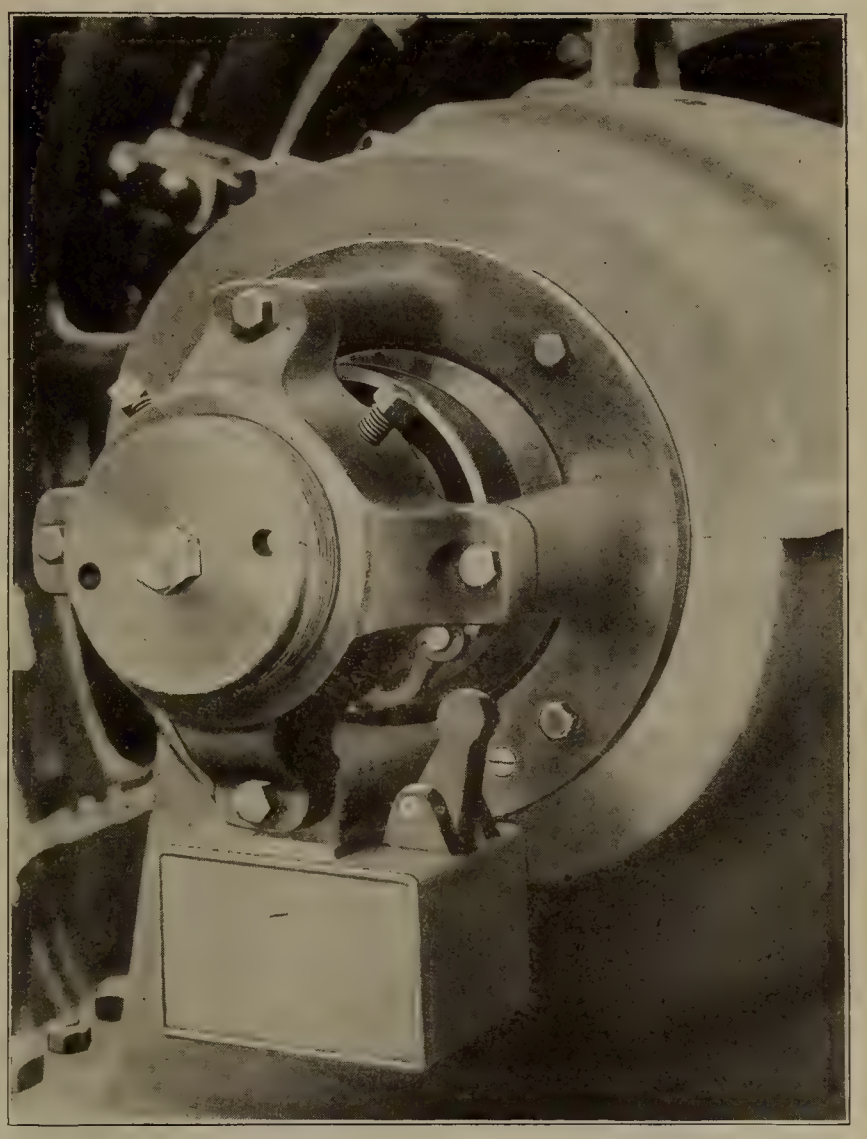
It is only necessary for the trip lever to move the arm a small distance, possibly 3/32 inch, to insure that the switch will close. The relation of the parts is such that, when the arm is in the closed position, the contacts are forced against the contact blocks with considerable pressure—much more pressure than is required to trip the switch.

To reset the switch it is merely necessary to move the switch arm back to the normal position by hand. This can be readily done at any time whether the machine is running or not and without opening the switch box.

That very few parts are involved is evident from an inspection of the illustration. Obviously, the fewer parts in a mechanism the better it is, other things being equal. The



Assembly of Overspeed Limit Device.



Overspeed Limit Device Installed on Rotary Converter.

minimum diameter for any bearing pin is ½ inch, and the other parts are correspondingly strong. Adjusting screws are provided whereby the position of the trip lever can be closely regulated so that it will act at the predetermined speed. The sensitiveness of action of the switch arm can also be regulated by an adjusting screw.

Electrical connections for the new device will be the same as those used for the former Westinghouse standard overspeed trip arrangement. If the converter attains an overspeed the trip lever flies out, the switch arm forces its contacts against the contact blocks and an auxiliary circuit is closed. With the usual scheme of connections, the closing of this circuit energizes the solenoid of a tripping device (on the alternating-current circuit breakers), which operates and opens the breakers, cutting the machine from its source of supply.

In addition to the overspeed limit switch illustrated, which must reset manually, another switch has been developed which can be reset by a solenoid arranged within the switch box. A circuit extends from the solenoid to the switchboard and the equipment is so designed that, after the switch has been tripped, it can be reset by closing the solenoid circuit with a contact button located at the switchboard or any other convenient point. This electrical resetting arrangement is not standard and is furnished only when specified by the purchaser.

PERE MARQUETTE RECEIVERSHIP.

The Pere Marquette R. R. was thrown into the hands of receivers by action of the Michigan State Railway Commission, April 4, in denying the road's request for permission to make a $4,000,000 bond issue.

LOCOMOTIVE BOILER TROUBLES*.

By J. W. Harkom, Consulting Engineer, Melbourne, P. Q.

The substitution of steel for iron, which west of the Atlantic had practically superseded the use of copper in inside fireboxes, brought with it a beginning of boiler troubles from which the earlier types of locomotives had been almost entirely free.

The cracking of side-sheets was a very serious item of expense and crippling of power, boxes would crack without any apparent cause.

The manufacture of steel plates for boiler construction was then in the experimental stage, and it was some time before it became common knowledge that the troubles arose more from chemical impurities in the metal than the actual manufacture and application of the steel plates.

Many of us can remember the reputation "Otis" steel obtained as superior to all other makes, due largely to its comparative freedom from sulphur and phosphorous.

When this trouble was about understood and met, then the demand for heavier locomotives brought about increased diameters of barrel shells which, with the introduction of coal as fuel, carried with them, in addition to the side sheet difficulties, trouble by breakage of staybolts.

The increased diameter of the shells necessitated a swelling out of top or saddle-sheet, producing a form known as the O.G.

Efforts were made to overcome breakages by increasing the size and strength of the stays, connecting the inner box with the casing or outside sheets.

This did not overcome the difficulty and the writer about that period formed the conclusion that the value of a staybolt, which, of necessity, must possess the requisite strength to retain the two sheets in the positions desired, lay rather in flexibility than excess of strength through increased diameter and consequent stiffness.

The cause of breakage evidently was the vibratory movement of the stay bolts due to increase of expansion of the inside box over the outside.

Repeated movement by expansion and contraction of the fireboxes caused the breakage, and as the movement of the sheet was greater at the top of box than at the bottom, the bolts at the point above referred to were subjected to a greater angle of vibration than those at the bottom, being of the same length by reason of the box being confined between the frames.

The amount of vertical movement of the inside box as compared with that of the outside box or casing varied with the height of firebox and its temperature.

Fireboxes which were not confined to the width between frames were about that time built, doing away with the O.G., not only for the reason above indicated, but to give more grate area and facilitate a reduced rate of fuel combustion per square foot of grate surface, which was increased in some cases over sixty per cent.

This latter, particularly, was done where the smaller sizes of anthracite coal were available as cheap fuel, but carried with it other difficulties of general construction which it is not proposed to deal with here, merely remarking that boilers with tubes too close to the grates do not give good results.

Some relief was afforded from the staybolt troubles, but it was for a very short period, as further demands for increased power, necessitating higher pressures and increased diameters of boiler shells, the O.G. staybolt troubles were generally as acute as ever.

Attempts have been made, and we are told with some success, to ameliorate the conditions by particular shapes and styles of staybolts, but the removal of the cause of the trouble has not yet to any very great extent been successfully made in general practice.

As previously mentioned, staybolts broke where the angle of vibration was greatest, and this was taken into consideration by the writer when studying how best to meet the trouble.

The conclusion come to was that if the length of staybolts could be increased in the same proportion as their movement with the inside box the same angle of vibration would result with the upper as with the lower staybolts, and the breakage would be less likely to occur.

This, of course, could not be attained, but in designing some fireboxes it was made imperative that a gradual increase in length should occur with every staybolt as it neared the O.G., and the length at that point was made as great as compatible with the general design and conditions.

The result was very satisfactory in the reduction of failures of staybolts, as confirmed very recently, after over five years' service.

One engine having this particular firebox, and repaired in January last, had only ten staybolts renewed after a year's work.

The increase in water space afforded materially assisted the boilers as regarded priming, the behavior of those engines being good in a bad water district.

With regard to the staying of firebox crown sheet of this boiler, by the sling stays at front end.

A criticism is offered *re* this to the effect that it is not carried far enough back, as in the writer's opinion sling stays with vertical freedom should entirely cover that part of firebox which is the first to be heated, therefore before pressure is developed that part of crown sheet is subjected to a strain which would be relieved by opportunity to expand upwards. The application of such slings at all is an admission of the correctness of the theory of such movement.

A noticeable feature of the firebox and casing is the single sheet forming the sides and crown sheet of inside box and the same for sides and saddle sheet of casing.

The writer adopted this plan some years ago, and the results have been satisfactory.

To the objection offered, "What if you have to put in a new crown sheet or sides," the answer was and is, "It is time enough to cut that sheet when you have to, and as easy to cut a clear sheet as a spliced one and a better chance to make a fresh joint."

If any careful examination of the exterior contour of a boiler is made when cold and compared with the same after steam is up an interesting study will be afforded the examiner.

While considering the staybolt question it is offered in conjunction with the conclusion regarding flexibility that the ideal staybolt would be not a bolt but a chain, which would give the freedom for vibration and yet tie the two sheets together.

Another and very fruitful source of trouble is leaky tubes.

The difference in longitudinal expansion of the firebox and tubes from that of the shell of the boiler to which they are rigidly connected presents a very difficult problem.

The setting of tubes in tube-sheets has been the subject of much experiment and careful observation, but it is fully clear that leakage occurs to tubes (when carefully set) at the firebox end only; where the expansion of the tube rearwards is met by the expansion of the firebox forwards, the results naturally being the destruction of the joint formed when the boiler was cold.

The increased length of both fireboxes and tubes has greatly aggravated the trouble and when careless handling of engines without fires takes place the shrinking of tubes in their diameters at firebox end accentuate the trouble

*From a paper read before the Canadian Railway Club.

which the subsequent restoration of equal temperatures of firebox and tubes cannot overcome.

This careless handling can, in the writer's view, be only partially met, but much can be done by use of substantial brick arches in firebox and the reduction of uncontrolled air admission, with the allowance of sufficient time for cooling when necessary.

The general construction of the latest types of boilers for heavy service, as illustrated in the technical journals, shows restrictions due to the large size and the necessary clearances, but the greatest change is in the flexible boiler due to the necessity for increased length to accommodate the motion of the whole vehicle over the roadbed, including switches.

To successfully maintain the efficiency of locomotives of the power recently developed, the writer believes that the articulated system must be followed with each set of cylinders and their drivers operated on the same truck wheel base, as first exemplified in the Fairlie and lately in the Mallet type.

That the boilers of such engines are too long to conveniently do this without being flexibly connected is apparent, and to those charged with the development of this necessity the writer gives his best wishes for success.

In the details of internal construction of boilers, the writer felt a few years ago that sufficient advantage had not then generally been taken of the improvements in forging machinery to dispense with many of the smaller members in the way of joints where upsetting of material and forging at even less expense than the older practice would reduce the number of parts and ensure better work.

That this is not now true may well be, and the writer does not offer these remarks as now justified, a correction being what he would like to hear from the members.

The increase from 140 lbs. pressure to 200 lbs. and over, with the accompanying increase in temperatures, and the increase in dimensions at all points, was undoubtedly the cause of most of the troubles in maintenance which may be in recent practice reduced chiefly to breakage of staybolts and leaky tubes and perhaps insufficient or incorrectly designed staying.

The reversion to pressures of under 180 lbs. in some recent designs proves to a certain extent the correctness of the foregoing.

With such reduced pressures and the advantages accruing from the use of super-heated steam, equally good results may be confidently looked for without some of the troubles attending the higher pressures.

With 63" drivers and 32" stroke, as in the case of the Mikado above referred to, a fairly high efficiency as regards fuel may be reasonably expected, provided the power is not wasted by high speed and light trains.

The introduction of superheating on locomotives, when not carried too far, cannot injure the boiler structure, and tends to fuel economy.

An interesting feature in development of modern boilers is the disappearance of the old wagon top and flat sides.

The only modern approach to it is the Belpaire, and many have been the tribulations attending them before the advent of flanging presses of sufficient size and power to successfully form the corners, which as intimated above, gave so much trouble.

The desire to provide storage for dry steam was the reason offered for these types of construction, but superheating has obviated that necessity.

The writer advocates the use of a steel casting covering the whole surface to be stayed, thus eliminating the use of a doubling plate as frequently practiced.

On this casting the attachments for stays project, and when the casting is made, say ¾" thick, the flat surface is better reinforced, with better opportunities for riveting and clearances for mountings.

The facing of the side of casting next to face plate gives a true surface and prevents any distortion of the face plate.

The writer recently saw in a technical journal that a locomotive engineer of repute had said it was better to make a narrow butt-strap for a joint than a wide one, by making the narrow strap thicker to gain the strength of joint needed.

Excess of stiffness anywhere in a boiler is undesirable.

Too wide a joint and too many rivets are certainly objectionable, but that designer is respectfully referred to the rules for joints as promulgated by the British Board of Trade for marine service, which, when intelligently followed, give the highest efficiency, and are applicable to all boilers, and scientifically correct.

Some time ago the writer was consulted as to a boiler for which certain inspectors had on examination of the drawings reduced the intended working pressure.

The builders thought they had done just about all they could to get what they wanted, but on examination of the drawings the writer found there were too many rivets in the joint and that by leaving out half those on the outer rows of the joint (a butt-strap design) the pressure should be, and was later allowed.

The recent issue by our railway commissioners of regulations for inspection and testing of locomotive boilers do not entail a very great amount of additional work or responsibility, outside the clerical work of reports, on Canadian railways.

The record of those railways in general is good, and that good record doubtless due to their conscientious efforts to secure efficiency and safety.

Some little points of indefiniteness as regards location of responsibility occur which should be cleared up as if any attempt is made to place responsibility it should be made clear in a thoroughly practical manner.

It also seems to the writer that by the number of reports and their frequency the Commission is taking on itself too much responsibility for regulating the conduct of the railways in detail.

If not promptly and invariably followed up where violations of instructions are apparent, and check inspections made, the result will be a worse state than before.

Heavier penalties for failure involving risk or actual damage to life and property would seem likely to be more efficient.

Discussion by A. A. Maver.

There is a statement to which I take exception, and that is this, "in the use of steel for these parts (boilers) it is certain that the United States practice led the way, etc." The first boiler built entirely of steel plate was made in Canada in the shops of the old Great Western Railway of Hamilton, Ontario. This road is now part of the Grand Trunk System. It created considerable interest at the time among railway mechanical men, both in Canada and the United States. This first steel boiler was made by Mr. Richard Eaton, who afterwards became Mechanical Superintendent of the Grand Trunk Railway.

With reference to the writer's suggestions that the staybolts would be increased in strength if they were gradually increased in length, as they rise afterwards from the mudring. Years ago I saw fireboxes built in this manner, the water space increasing in width towards the top, but the reason given for this was not so much for the purpose of increasing the strength of the staybolts as for improving the water circulation, although I have no doubt it would also have the effect suggested by the writer.

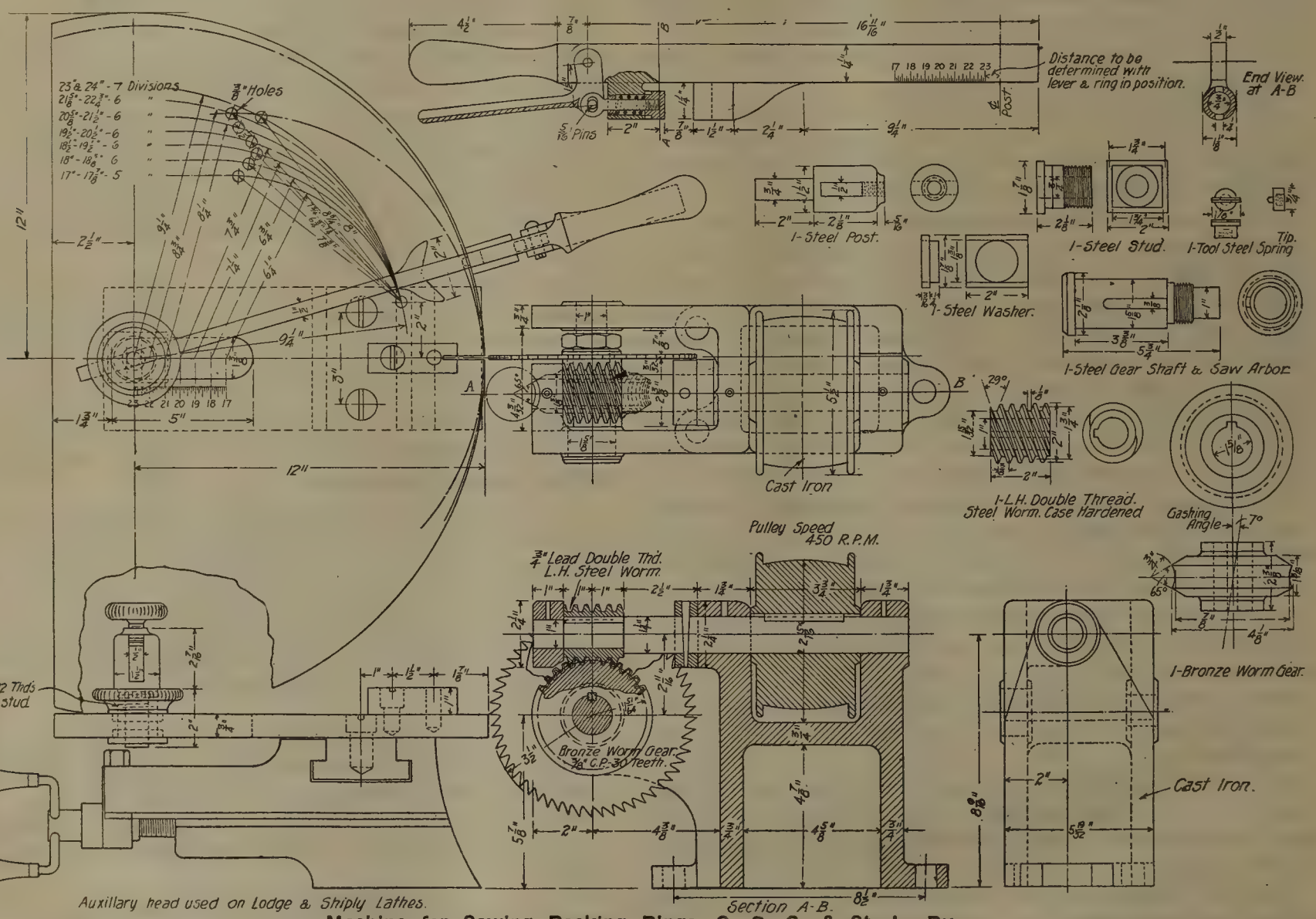
As you all know, the expansion of a sheet is from the center outward but the side sheets must expand vertically upward, because they are held rigidly at the bottom by the mudring, therefore all the expansion is upward, and the extreme movement is along the "O.G.," as stated in the paper, and it is there we experience the trouble with broken staybolts, and also due to the horizontal expansion of the sheets we have breakages of the bolts at the extreme back and front vertical rows, also in the upper corners back and front, the staybolts in these corners being subjected to a vertical, as well as a horizontal movement. This is what is known as the "breaking zone," and some two years ago we put flexible staybolts in a number of our boilers in this breaking zone, in order to overcome the trouble experienced by the breaking of these staybolts, and up to the present time we have had none of these flexible staybolts break.

piece. This was practiced twenty-five years ago, to my knowledge, not only on the inside shell but on the outside as well.

Referring to the suggestion made by Mr. Harkom that the sagging of the tubes might be prevented by placing a bridge or a carrier tube sheet to carry the tubes at the centre. That idea occurred to us, but after thinking the matter over and considering that in the course of time there tubes would be encrusted with perhaps one-quarter of an inch of scale, and as each tube would have to be drawn out of its own hole, we gave up this idea.

PACKING CUTTING MACHINE.

A machine for cutting up sectional packing rings at the Beech Grove shops of the Cleveland, Cincinnati, Chicago & St. Louis Ry. is shown in the sketch herewith. The table is semi-circular in shape with a radius of 12 inches, and a 6x3/32-inch Brown & Sharpe saw runs in a slot at one side. The clutch or lever clasps the packing and moves it to position on the saw. The right lengths, or sections, are obtained by pegs set in the table, divided similar to a dividing head on milling machine.


23" a 24" - 7 Divisions
21⅝" - 22¾" - 6 "
20⅝" - 21½" - 6 "
19½" - 20⅝" - 6 "
18½" - 19½" - 6 "
18" - 18⅝" - 6 "
17" - 17⅝" - 5 "
⅜" Holes
12"
5" Pins
Distance to be determined with lever & ring in position.
End View at A-B
1-Steel Post.
1-Steel Stud.
1-Tool Steel Spring
1-Steel Washer.
1-Steel Gear Shaft & Saw Arbor.
Cast Iron
1-L.H. Double Thread. Steel Worm. Case Hardened
Gashing Angle
Pulley Speed 450 R.P.M.
¾" Lead Double Thd. L.H. Steel Worm.
⅞" 12 Thds Grip stud.
Bronze Worm Gear. 36 C.P. 30 Teeth.
1-Bronze Worm Gear.
Cast Iron.
Auxillary head used on Lodge & Shiply Lathes.
Section A-B.

Machine for Sawing Packing Rings, C. C. C. & St. L. Ry.

I note what is said in regard to leakage of tubes due to expansion. I hardly think we have leakage due to this cause, but rather to shrinkage. The longer the tube the greater the sag, and expansion would simply increase this sag, but it must be borne in mind that the expansion of the tube is relieved by the expansion of the barrel of the boiler. In large boilers the barrel will expand probably ⅝ of an inch between tube sheets. On the other hand if shrinkage takes place it will be relieved by the straightening of the sag. If shrinkage still continues the tubes will start in the sheet and leakage will occur, so I attribute leakage to shrinkage rather than expansion.

The writer states that the crown sheet, being the first part heated, it should be allowed freedom to rise. In my opinion this sheet does not rise until the side sheets are heated. It is the side sheets which create the vertical movement, and by the time they are heated the outside shell is also heated, thereby giving more freedom to the vertical movement of the crown sheet.

With reference to the side and crown sheets being in one

The sawing operation may be followed through in this manner. The handle on the table, as shown in the sketch, is in position to lay the packing ring on the table and saw the first slot. The clutch on handle is then released from the packing ring and the handle is moved against a peg in one of the holes in the table at the left. This certain hole is determined by the diameter of the packing ring, as shown on the sketch. The clutch is applied again and the packing ring is moved to the original position and sawed the second time. These operations are continued till ring is sawed in the required number of sections. It requires 10 to 12 seconds to saw a slot in a packing ring, or the entire ring may be sawed in less than a minute.

Baldwin-Westinghouse Locomotive for Piedmont Traction Co.

HIGHEST VOLTAGE DIRECT-CURRENT LOCOMOTIVE.

Recently the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company completed equipping a high voltage electric locomotive for the Piedmont Traction Company, which will operate an extensive railroad system in the Piedmont section in North and South Carolina. This locomotive is one of six to operate at a pressure of 1,500 volts direct-current. This voltage is said to be the highest direct-current voltage used by any electric railway in the United States.

The mechanical parts were built by the Baldwin Works, Philadelphia, Pa. The locomotives weigh 55 tons each and are equipped with four Westinghouse motors which have a rating of 180 horsepower. Each locomotive is able to haul 40 freight cars weighing 45 tons each with load, at 20.5 miles per hour on a straight level track, or nine cars at the same speed on a 1 per cent grade.

The motor equipment is controlled by the Westinghouse electro-pneumatic unit switch type of control.

Steel construction is used throughout. The underframing is built of steel channels and the cab-sheets are mounted on a steel angle-iron frame.

All-Steel Street Railway Train.

PITTSBURGH RAILWAY'S STEEL CAR TRAINS.

On the previous page is shown what is believed to be the first steel surface street railway train operated in this country. The train is in daily service on the Frankstown Avenue line of the Pittsburgh Railways Company. The motor car is equipped with four Westinghouse No. 306 interpole motors, 50 h. p., and HL control. The car has been in operation since January 20, 1911, and has averaged approximately 130 miles daily since. There have been no control failures of any consequence during the period.

The motor car is of Brill Manufacture and is of a unique design developed by the railway. Its weight, including trucks and equipment, is 46,000 lbs. The seating capacity, including that of the folding seat on the rear platform, is 61 persons, giving the low weight per seated passenger of 754 pounds. Important features of the car are the door opening devices on which patents have been granted to Mr. P. N. Jones, general superintendent of the company. The hand-operated rear door opening device is so arranged that the doors open inward over a stationary step. There is no folding step with hinges to cause accidents or to wear out and there is no grab handle or step exposed when the door is closed. No part of the door extends beyond the side of the car. The front door slides, is air operated and is controlled by a small valve just above the hand brake wheel. Accidents with these cars have been reduced to a minimum due to the fact that the steps are entirely enclosed while the cars are moving.

The most noteworthy feature of the steel trailer is that the boarding step of the center door is very low, which facilitates rapid loading and unloading. The train is used in the evenings as a "Theatre Special" to carry passengers from theatres in the city to Wilkinsburg, one of the suburban boroughs.

ATLANTIC CITY SPECIAL TRAIN.

The Pennsylvania R. R. has announced a special train for the Atlantic City conventions. This train will leave Chicago at 3 p. m., June 10, reaching Atlantic City at 2 p. m., June 11. It will be made up of the usual Pullman sleepers, compartment diners, library, smoking, and observation cars.

RUBBER.

The many uses for rubber in railway operation call for a more than ordinary knowledge of the subject on the part of the railway mechanical official.

The following is taken from a paper by Dr. W. C. Geer before the Cleveland Engineering Society:

Crude Rubber.

The first historical reference to rubber was in 1525, by a Spanish writer, who described some rubber ball playing seen by him in Mexico. In 1731, the Paris Academy of Science sent an expedition to South America to obtain certain geographical measurements and they brought back specimens of rubber. They found a tree called Hevea by the natives, which gave forth a milk-white liquor which hardened and blackened in the air. They found the natives coating linen with this material and making watertight boots. Samples came into England about 1770, and Priestley, the chemist, recommended it for the purpose of erasing pencil marks; hence, the name rubber. Since it came through the West Indies, it was called India rubber, although this term is today a misnomer.

Sources of Crude Rubber.

Rubber bearing plants are found in considerable tracts of tropical and sub-tropical zones in South and Central America, Asia, Africa and Australia. The species are very numerous. The chief botanical orders are: Euphorbiaceae, Apocynaceae, Urticaceae, and Compositae.

Of the Euphorbiaceae, the most important is the genus, Hevea, from the species Hevea-brasiliensis, of which about 60 per cent of the world's total output of rubber is obtained. It is predominant over large tracks of South America, in the Amazon valley particularly. In the natural state it is a large tree growing to the height of 100 ft. and a diameter up to 40 ins. It has been frequently stated that not more than a small proportion of the trees in the vast forests bordering the Amazon, the Rio Negro and Rio Madeira, etc., have been exploited.

The trees are tapped by means of a small iron hatchet, having a blade about 1 in. broad, making incisions, deep cuts and oblique lines. There are a large number of methods of tapping. About 35 consecutive daily tappings are necessary. Small collecting cups are fixed to the tree by means of moist clay. The rubber runs out then in the form of a white milk or latex into these cups. An average annual yield in the Amazon is 5 lbs. of dry rubber, although very variable. The latex is then transferred from the collecting cups into pails and from the latter into a flat basin and then it is coagulated by means of the smoking process.

A fire is made of a material giving a rich, dense smoke, particularly the fruit of the Urucuri palm. A small quantity of the latex is poured on a long pole which is rotated in the smoke until it is dried or "cured," then a fresh quantity is poured on and the rotation continued, and this operation is repeated until a biscuit or ball of rubber weighing from 20 to 100 lbs. is formed. This ball consists of innumerable thin layers and forms the fine para of commerce. Other commercial varieties are: Cameta, coarse, Mollendo, etc.

There are many grades of rubber produced in Africa, which belong to the order, chiefly Apocynaceae, of which the main genera are: Funtumia, Landolphia and Clitandra. The Funtumia yield grades of rubber known in the trade as Gold Coast lumps, Ivory Coast lumps, Niggers and some of the Congo and Cameroon varieties. It is a mature forest tree with a circumference of about 40 ins. and rises to a height of from 40 to 50 ft. The Landolphia varieties are creepers and vines up to 6 ins. in diameter, and give among others the well known commercial brands of the Congo varieties, red and black, Upper Congo balls, Equateur, Madagascar, etc. The latex is coagulated in a variety of ways, sometimes by smearing the latex on the body and allowing the natural heat to evaporate the water and, subsequently, stripping the rubber; sometimes by boiling and smoking. Some of the ball rubbers are obtained by applying a coagulant, such as chalk, or by cutting the vine and drawing the thread of rubber thus obtained to form a core, subsequently winding more and more thread around the core until the ball is obtained. The vines are difficult to tap and, consequently, they are generally cut down and bled to death.

The Rubber Latex.

Under the microscope it consists of a fluid with innumerable particles of globular shape. The constituents are various sugars, crystalline substances which are derivatives of oxygen, enzymes, water, rubber, resin, etc. A typical average analysis of a latex from Hevea-brasiliensis Ceylon showed:

Rubber	32.00 per cent
Resin	2.03 per cent
Proteid	2.03 per cent
Mineral matter	0.00 per cent
Sugars	0.00 per cent
Water	55.56 per cent

Coagulation involves physical and chemical changes not yet fully known.

Chemistry of Crude Rubber.

The chemistry of crude rubber divides itself naturally into two divisions:

(a) That of the rubber hydro-carbon.
(b) That of the secondary constituents.

On analysis the rubber hydro-carbon has been found to contain carbon and hydrogen in the proportions of the formula, $C_{10}H_{16}$, that is, it has the same ultimate chemical composition as the fundamental constituent of turpentine and of a vast number of other bodies known as "terpenes." It is a colloid and probably to its colloidal character may be ascribed its value. A great deal of work has been done during the past few years on the synthetic production of the rubber hydro-carbon. The literature contains a large number of articles and the patent literature is now becoming extended. It has, however, as yet not advanced to the stage when it may be called a large commercial proposition.

The chemistry of the secondary constituents includes those of the resins, which are found in the crude rubber. This term is a broad one to include substances which may be extracted from crude rubber by means of acetone and similar solvents. The amount of such resin varies in different crude rubbers and indeed varies in different lots of the same crude rubber. There is also contained, in very small quantities, certain mineral matters and numerous other, rather complicated, organic chemical bodies.

Crude rubber, as it comes into the market, includes both the pure hydro-carbon and secondary constituents as one body together. The specific gravity is about 0.90. It softens in the neighborhood of 245 degrees Fahr. and becomes clear liquid at about 370 degrees Fahr., although these figures are very variable, depending upon the particular grade of crude rubber that is examined and the treatment that the rubber has received up to the time that the test is made. Rubber swells and forms pseudo solutions with petroleum and coal-tar hydro-carbons, carbon bisulphide, carbon tetrachloride and other solvents, although it is insoluble in alcohol, acetone, and groups of solvents of a similar character. It is a soft, sticky, rather plastic material, possessing, when washed and dried, and sheeted together, but little tensile strength, it can be easily molded, the color is variable from the light yellow crepe Ceylon and plantation rubbers, to the red from Africa and the black of other grades of African rubber, dark green Guayule from Mexico, amber brown of the Fine Para from South America, in its washed and dried condition. When a fresh biscuit is cut and the surface exposed to the air for the first time, the rubber is usually white in color. This white color rapidly changes to brown, or black on being exposed to the air.

Vulcanization.

The rubber industry was not an industry and probably would not have become one of any size had it not been for the remarkable discovery of the process of vulcanization by Goodyear in 1839 and again by Hancock in 1844. These gentlemen found that sulphur unites chemically with rubber and gives more highly developed properties than were possessed by the original unsulphured material.

To accomplish the process of vulcanization, the rubber and sulphur are mixed together by any method, usually, however, by two mixing rolls, then made into any desired form and finally heated to temperatures varying from 250 to 320 degrees Fahr. for a chosen length of time. After this heating it is found that the rubber has united with the sulphur and it is said to be vulcanized.

Vulcanization is also possible by means of the liquid sulphur monochloride (S_2C1_2), which was discovered by Parkes in 1846, and by means of which rubber in thin sheets can be vulcanized at the ordinary room temperature. This, however, forms but a relatively small division of the rubber industry.

Other differences between vulcanized and unvulcanized rubber are numerous. Generally speaking, vulcanized rubber tends to deteriorate more rapidly than the unvulcanized rubber under similar conditions. Preserved in the dark and where cool, both vulcanized and unvulcanized rubber can be preserved for periods of many years. But at temperatures around 160 degrees Fahr., or over, they harden appreciably with age in a short time, and when exposed to the light, they undergo rapid oxidation. Dilute acids and alkalies do not attack them appreciably, but strong sulphuric and strong nitric acids cause very rapid decomposition. Numerous oils cause a softening and weakening of the composition.

There are other physical and chemical properties of vulcanized rubber which, however, will be passed over, since they are details.

Raw Materials of the Rubber Industry.

Crude rubber and sulphur have been spoken of as two essentials. That is very true. However, in rubber mixings a large number of different materials of various kinds are used. Of these, reclaimed rubber occupies quite a prominent position. Reclaimed rubber is made from old vulcanized rubber, freeing it from the cloth made into the article and softening it. Numerous patented processes for this purpose are in vogue. It forms a very valuable material for rubber mixing of different purposes.

Rubber substitutes made by the oxidation or sulphurization of different drying oils are used to a limited extent.

Such dry mineral pigments as zinc oxide, lithopone, barytes, whiting, litharge, etc., have their own particular uses.

The rubber composition for any purpose, therefore, is not a mixture of rubber and sulphur alone, but of rubber, sulphur and those other materials which will give the highest service and the best value for the purpose for which they are intended.

There is a great deal of misinformation prevailing upon the subject of the rubber compounding materials. It is perhaps generally believed that dry pigments are used merely for the purpose of cheapening and most people, when they hear of reclaimed rubber, consider it merely a matter of old scrap that is thrown back into the compound in order to increase the profits of the rubber manufacturer. This, however, is far from the actual truth. It is the purpose of the rubber manufacturer to produce articles which will serve the purpose in the best way, give the longest life and have the best value. One might desire to use mahogany for a building material, but it would scarcely be considered good judgment; on the other hand, pine is an excellent building material. Mahogany has its particular uses, oak has its particular uses, and pine has its particular uses. It is the same way with rubber. Each article is manufactured from a mixture that will give the best service and the best value. Of the large number of rubber articles, hose, belting, packing, tires, water bottles, etc., each has certain definite uses and, consequently, the rubber compound or mixtures must be made according to the service for which each is to be put and the rubber manufacturer reaches his highest skill in so combining the different raw materials and manufacturing them into articles which will give the highest efficiency in service.

Specifications for Rubber Articles, Chemical Analysis and Physical Examination to Determine Whether the Article Will Meet the Specifications.

The Chemical Analysis of Vulcanized Rubber.

A sample of vulcanized rubber to be analyzed must first be ground or cut into very fine pieces. It is then, (1) submitted to the action of acetone which extracts resins, some oils and free sulphur. The free sulphur is then determined by standard chemical methods and the difference between that and the total amount of the extract is usually computed as resins. The residue is then, (2), extracted with pyridine which dissolves tar, pitch, bitumen, etc. The residue is then extracted, (3), with alcoholic potash which dissolves oxidized and sulphurized oils which are saponifiable. This shows, in

other words, rubber substitute. The residue from the alcoholic potash extraction is then treated, by some chemists, with, (4), nitro-naphthaline which extracts rubber, gutta percha, balata, etc., and the final residue, sometimes, is extracted in, (5), boiling water to dissolve starch, sugar, etc., which leaves, (6), mineral matter, free carbon, cotton fibers, etc. Separate estimations are made to determine total sulphur. The methods of chemical analysis are, however, notably unreliable, and there is a vast difference between the figures obtained by processes such as these and those obtained by gravimetric and accurate volumetric determinations. It is an impossibility to distinguish between reclaimed rubbers and crude rubber. Consequently, no methods of chemical analysis can definitely prove or disprove the presence of any kind of crude rubber.

Physical Tests of Rubber Articles.

The most important division of the testing of rubber materials is the physical tests, of which tensil strength in pounds per square inch is, perhaps, the most trustworthy. It is unnecessary to enter into the details of physical testing methods before engineers. The details are worked out to suit the peculiarities of the rubber, namely, a relatively low tensile strength, ranging from 100 to 4,000 lbs. per square inch, and a very high elongation at the point of rupture, the elongation being from 150 to 1,500 per cent. The permanent elongation measured, usually 10 minutes after rupture, is a valuable property.

The size and shape of the test piece is of moment. In the railroad specifications, pieces are usually cut 1 in. wide throughout the entire length, but practical experience and scientific study has demonstrated that it is just as necessary in testing rubber samples to have enlarged ends as it is in testing steel samples. The influence of small irregularities, pieces of dirt, etc., which are inevitable in any rubber goods, have such a tremendous influence upon the tensible strength that it is necessary that the part of the test piece held in the jaws of the machine be large. In Germany a very popular testing method is in the form of small rings, something similar, but smaller in size to the jar rings used in preserving fruits. It has the disadvantage, however, of a very small size and consequently a very low actual breaking strength. The influence of irregularities is very much more marked in pieces of this size than in larger pieces.

To determine the length of time by aging tests which a rubber article will last is important and much study is under way in this direction.

Service tests, such as steaming for steam hose, treating with oils, etc., or materials to be subjected to those compounds are carried out only to a limited extent. This field, however, is of great value and will, undoubtedly, be extended in the future as a means of determining the value of articles.

Specifications.

You will, I am sure, be interested in some remarks upon the writing of specifications for rubber goods, for, I think, that those of you who are familiar with this branch of the industry will agree with me that there is no side of the rubber business which is so crudely worked out, nor one upon which accurate and reliable work can be done to greater advantage. When you or I desire to buy an article, it is quite natural that we, knowing the use to which it is to be put, should establish a set of specifications. These specifications are intended to establish a standard for the article to which each purchase must measure to give us a uniform quality of the material or article. The importance of this matter is so great that it is of moment to determine the kind of specifications to draw and the kind of tests to prescribe. Obviously such specifications and debts must be developed in the light of knowledge of the material to be specified.

There are two extremes of specifications:

(1) Specifying chemical composition, physical tests and services as is done in some United States navy specifications.

(2) The other specifying by one physical property which is done in the Master Car Builders' specifications for air brake hose.

Neither of these extremes will give the best article or the best value.

To obtain correct specifications, all mention of chemical composition should be eliminated. Based primarily upon the fundamental principle that the percentage of crude rubber cannot be positively determined and the influence of the different mineral matters, etc., are known to the rubber manufacturer chiefly, the specification of a percentage of pure Fine Para is at best uncertain. Strictly speaking, pure Fine Para is the crude rubber obtained in the smoking process on the Amazon and tributaries. The term "Pure Fine Para" should include not only the rubber obtained from the Amazon, but also rubber from the tree Hevea-brasiliensis, made anywhere in the world. The term "Para" is derived from the town Para, but practically applies to rubber from the foregoing tree. In view of the fact that Para rubber, Congo rubber, etc., differ from each other in their crude state by the percentage of acetone usually found, chemists have been in the habit of stating that pure Fine Para is present when the acetone extract is low and not present when it is high. Here specifications are uncertain and testing methods unreliable since this test does not prove nor disprove the presence of any grade of rubber and much depends upon the analyst's judgment.

The only determination today made is that of rubber hydro-carbon, and since this varies in properties, tensile strength, aging properties, etc., it is useless to attempt to specify it.

In the same way the specification of sulphur of mineral matter or any other kind of added material is not warranted. Any attempts by buyers or consumers to make specincations covering these matters would be, at best, uncertain. The best way, therefore, is to specify that the article must comply with certain physical requirements and leave it wholly to the manufacturer to decide on what chemical composition will meet these specifications.

Physical Properties.

The buyer can establish physical properties and lay out tests to determine them which will show the value of the article for his purpose. They should be made severe, but well balanced. Tensile strength, elongation and recovery should be specified in terms that will give the highest possible value as required for the aritcle in question.

You buy vanadium steel, high carbon steel, bronze, etc., not because of their respective composition, but because that composition has been shown to have certain valuable properties. It is, after all, the properties that we buy.

Service Tests.

Comparative service and aging tests should be required. The objection has been frequently raised and probably will be raised by some of you that it is a difficult matter to place, under any conditions, an article and then age it so that in a short time it is possible to deduce the effects of long use.

However, granted that the difficulty is great, it is not insurmountable. What is desired is not so much that the rubber be completely used up in a service test as that the rate of deterioration be determined. Given then the rate of deterioration of hose, the quality of which in service is well known, and it is perfectly possible to predict from a curve the comparative aging value of the unknown.

If consumer and producer will co-operate, these service tests can be developed and to the advantage of all concerned.

Personals

C. A. Leavitt succeeds A. Ashcraft as master mechanic of the Arkansas Central, with office at Paris, Ark.

S. L. Tracy has been appointed general foreman of the Bangor & Aroostook at Houlton, Me., succeeding A. J. Smith.

H. H. Shepard has been appointed general superintendent of the Charlotte Harbor & Northern, with office at Boea Grande, Fla.

H. G. Love succeeds C. J. Wymer as general car inspector of the Chicago & Eastern Illinois at Danville, Ill.

J. J. Murphy has been appointed shop foreman of the Chicago & North-Western at Fremont, Neb., to succeed W. Smith.

G. S. Wilber has been appointed master mechanic of the Burlington at St. Joseph, Mo. H. S. Mored has been appointed to fill a similar position at Ottumwa, Ia. H. C. Turner has been appointed road foreman of engines at Burlington, Ia.

J. T. Dollarhide succeeds A. Guempilein as locomotive foreman at Kansas City, Mo., on the Chicago Great Western.

Edward Thomas succeeds J. H. Watson as foreman of the Oregon-Washington R. R. & N., with office at La Grande, Ore.

T. E. Cannon has been appointed general master mechanic of the Lake district of the Great Northern, with headquarters at Superior, Wis. Nels Osgard succeeds Mr. Cannon as master mechanic at Superior. S. J. Fero succeeds C. E. McLaughlin as master mechanic at Breckenridge, Minn.

Geo. Langton has been appointed master mechanic of the Texas & Pacific at Marshall, Texas, succeeding O. A. Clarke.

Geo. H. McCutchin succeeds F. McGehee as master mechanic of the Hayneville & Montgomery, with office at Hayneville, Ala.

Thomas Edwards has been appointed master mechanic of the Holton Interurban, vice C. W. Buckle, with office at El Centro, Colo.

W. H. Wheeler succeeds A. Newby as master mechanic of the Louisiana & Pine Bluff, with office at Huttig, Ark.

J. B. Kenison has been appointed foreman of the Maine Central at Calais, Me.

F. E. Ballda has been appointed master mechanic of the New York, New Haven & Hartford at East Hartford, Conn., to succeed J. M. Collins.

G. H. Huntley succeeds J. B. Beaird as master mechanic of the North Louisiana & Gulf. His office is at Hodge, La.

E. G. Dunn has been made acting superintendent of transportation of the Pacific & Idaho Northern, vice P. G. Williams, with office at New Meadows, Idaho.

F. E. Sullivan succeeds R. H. Moore as general manager of the Pajaro Valley Consolidated, with office at Spreckels, Cal.

A. T. Mauldin has been appointed foreman of car repairs of the Southern at Selma, Ala., and E. F. Rucks has been appointed to a similar position at Birmingham, Ala.

J. C. Arbogast has been appointed general manager of the Tennessee & North Carolina, with headquarters at Philadelphia. He succeeds F. F. Robb.

H. E. Passmore has been appointed master mechanic of the Toledo & Ohio Central and Zanesville & Western Rys., with office at Bucyrus, O. He succeeds J. T. Luscombe, who has been appointed master mechanic of the Big Four.

E. E. Backus succeeds E. J. Cordova as purchasing agent of the Vera Cruz Terminal, with office at Vera Cruz, V. C., Mexico.

J. B. Kilpatrick, superintendent of motive power of the Rock Island at Davenport, Ia., has had his office moved to Des Moines, Ia. W. M. Whitenton, general manager of the first district, and F. J. Easley, general superintendent, have also had their offices moved to Des Moines.

H. E. Passmore.

W. R. Ladd, formerly assistant superintendent of the Oregon-Washington R. R. & N. has been appointed master mechanic of the shops at Albina, Ore. W. H. Dressel has been appointed assistant superintendent to succeed Mr. Ladd at Portland. J. H. Watson has been made division foreman at Seattle, Wash., to succeed Mr. Dressel. Edward Thomas has been appointed division foreman at La Grande, Ore., succeeding Mr. Watson.

S. G. Strickland has been appointed assistant general manager of the Chicago & North Western at Chicago to succeed W. E. Morse, retired on account of ill health. W. J. Towne succeeds Mr. Strickland as general superintendent at Chicago. H. H. Decker, formerly division engineer at Winona, Minn., succeeds Mr. Towne as engineer maintenance of way at Chicago. Numerous other changes have taken place in the operating and engineering departments.

Willard Kells.

Willard Kells has been appointed assistant general superintendent of motive power of the Atlantic Coast Line, with office at Wilmington, N. C. Mr. Kells resigned as master

mechanic of the Lehigh Valley in December, 1910, to accept the position of assistant to the general superintendent of motive power of the Atlantic Coast Line and has held this position until his recent appointment. Mr. Kells was born in 1868 at Dennison, Ohio, and has come up through the mechanical department, starting at the bottom as an apprentice in the Susquehanna shop of the Erie. He filled various positions, arriving at the position of master mechanic in 1896. In 1903 he went to the Lehigh Valley to accept a similar position and remained with this road until 1906.

J. D. Wells has been appointed district master mechanic at Farnham, Que., on the Eastern division of the Canadian Pacific. He succeeds A. W. Horsey. E. Eley succeeds T. Harris as division car foreman at North Bay, Ont., on the Lake Superior division.

P. P. Mirtz has been appointed mechanical engineer of the New York Central Lines West, with office at Cleveland, O. Mr. Mirtz was born in Scranton, Pa., in 1883. In 1899 he entered service of the American Locomotive Co. as draftsman apprentice and in 1901 entered the service of the Central of New Jersey as mechanical draftsman. In 1903 he accepted a similar position with the N. Y. C. & St. L. at Cleveland and in 1905 entered the service of the Erie R. R. at Meadville, Pa., as mechanical draftsman. Mr. Mirtz came to the Lake Shore in 1906, in 1907 he was appointed assistant chief draftsman at the Collinwood shops, was made chief draftsman at Elkhart in 1909 and in 1910 was appointed assistant engineer of motive power which position he held until his present appointment.

Nels Osgard.

engine wiper for the Great Northern (then the St. P. M. & M.). In 1890 he was advanced to fireman and in 1896 was given an engine. In April, 1906, he was appointed traveling engineer and with a brief exception during the interval of depression, he served in this capacity until March 15, 1912, when he was appointed division master mechanic of the Superior and Mesabe divisions as noted.

Geo. K. Stewart.

George K. Stewart has been appointed master mechanic of the Missouri Pacific-Iron Mountain system at Coffeyville, Kan. Mr. Stewart was born Aug. 5, 1869 at Ottawa, Kan., and was educated in the public schools there. In 1889 he entered the Topeka shops of the Santa Fe as a machinist apprentice and remained with this road until 1898 when he entered the service of the Missouri Pacific system as a machinist and has been in the employ of this road continuously since that time. He served three years as a roundhouse foreman at Coffeyville, Kan., and in 1909 was appointed division foreman at Wichita, Kan., where he remained until March 4, 1912, when he was appointed a master mechanic and transferred back to Coffeyville.

Nels Osgard has been appointed master mechanic of the Great Northern at Superior, Wis. Mr. Osgard received a county school education and started at the bottom in October, 1887, as

OBITUARY.

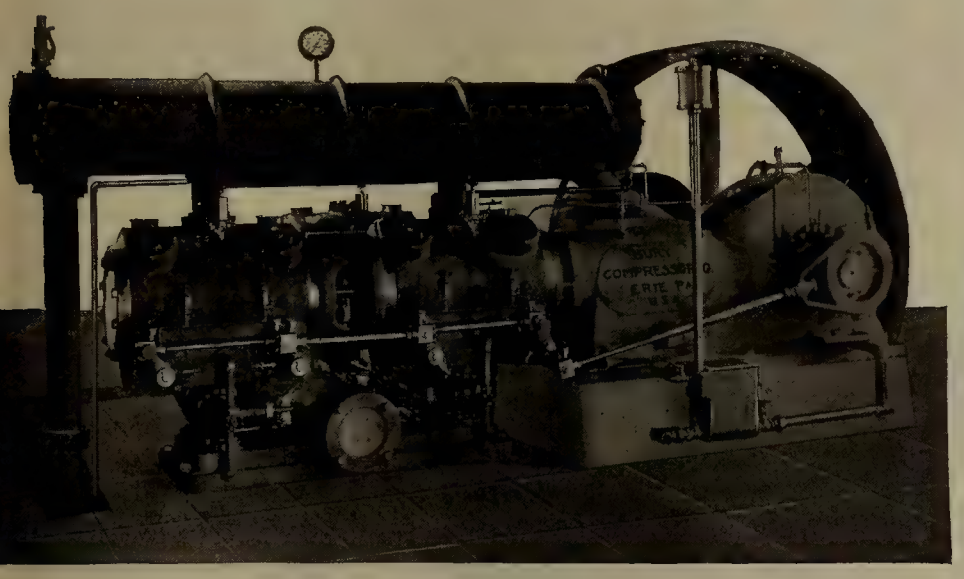
R. F. McKenna, formerly master car builder of the Delaware, Lackawanna & Western, died at Philadelphia on March 16. Mr. McKenna was born at Scranton, Pa., in 1868, and spent practically all of his railroad career on the Lackawanna, entering the Scranton shops in 1884 as an apprentice. He became chief draftsman of the car department in 1891, and during 1892 was connected with the Buffalo Car Wheel Co. He returned to the Lackawanna as foreman of the Scranton car shop. In 1899 he was appointed a general foreman and in 1903 was made superintendent of the car shop. In 1904 he was appointed master car builder and continued in this capacity until he resigned in 1909 on account of ill health. His death came as the result of an operation. Mr. McKenna was a former president of the Master Car Builders' Association and of the Central Railway Club.

R. F. McKenna.

Among The Manufacturers

NEW COMPRESSOR.

The Bury Compressor Co., Erie, Pa., has placed on the market a variable volume compressor driven by belt from a band wheel on the compressor. The capacity of this machine is 1,500 feet displacement per minute and it was installed recently in the Erie Malleable Iron Co.'s plant. The machine was started off under load immediately upon completion and it is said to have been carrying full load since, and is maintaining terminal air pressure at the required



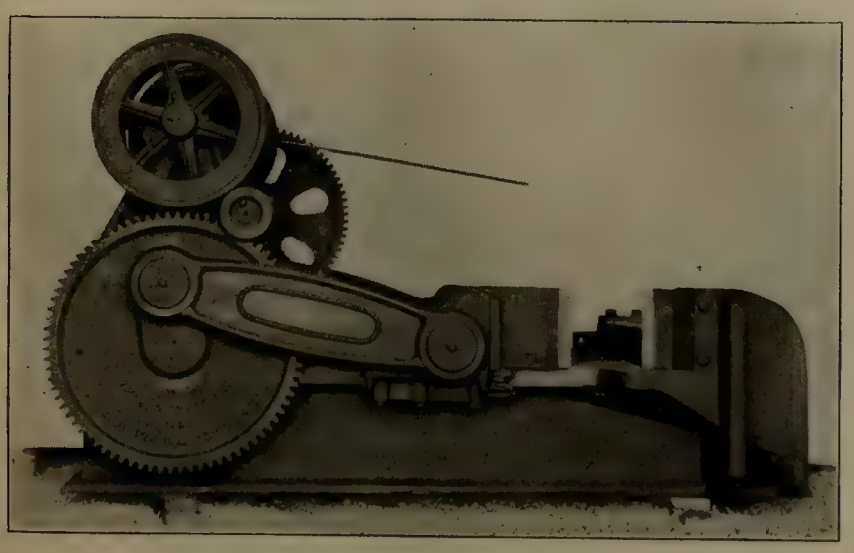
Bury Air Compressor.

point under the varying load of that part of the large plant where the various machines and tools are located, operated by air from this compressor.

This machine is also built to be driven by a synchronous motor mounted directly on the shaft. The Bury Compressor Co. has four large machines of this type now under construction going through its shop, and in its January orders has been favored with large 10-inch and 16-inch stroke machines from the Anheuser-Busch Brewing Association, St. Louis, Mo.; Lord & Burnham, Irvington-on-the-Hudson; North & Judd Co., New Britain, Conn.

WOOD SPLITTING BULLDOZER.

A special bulldozer adapted for splitting up old ties and timbers is shown in the illustration. This is one of the regular machines of Williams, White & Co., of Moline, Ill., which has been fitted up for this purpose and has proven to be a very useful machine. Heavy steel knives have been bolted to the sides of the jaws and these cut the wood off into lengths of from two to three feet. In addition to this there is a horizontal knife at the front of the machine which splits the piece of wood through the middle. As a number of blows are necessary to cut off a piece of timber, this horizontal knife crushes and splits the wood into a half dozen or more pieces before the operation is finished.



Wood Splitting Bulldozer.

The C., M. & St. P. Ry. has one of these machines driven by a 20 h. p. gasoline engine and mounted on a platform so that it can easily be placed on a flat car. When a pile of old timbers has accumulated at some point along the line, the bulldozer is loaded on a car and shipped out to that point where it quickly makes kindling wood of everything in sight. It then proceeds to the next point along the line which is in need of kindling wood. This wood is very useful at round houses for starting fires under boilers and this bulldozer furnishes it quickly and cheaply.

New Literature

The March issue of "Small Motors," issued by the industrial and power department of the Westinghouse Electric and Manufacturing Company, Pittsburgh, is devoted to electric motor vehicles. Considerable valuable information is contained therein with reference to the operation of these vehicles and their production of revenue to the central station.

* * *

"Lea high-duty turbine pump" is the title of a recent bulletin of the Lea Equipment Co., of Philadelphia, Pa. It illustrates and describes in very good style the several types of centrifugal pumps made by this firm. The general offices of the Lea Equipment Co. have recently been moved to the works at Wayne Jct.

* * *

Bulletin B of the Vixen File Co., of Philadelphia, shows a large assortment of Vixen files together with complete descriptions. The preface says that Vixen files cut three hundred to five hundred per cent faster than ordinary files.

* * *

The Crucible Steel Co., of Pittsburgh, has issued an interesting little booklet on "Steels and alloys for special purposes." It contains considerable data and other interesting matter on the subject of steels in general. Description of a number of tests are given, together with tables and curves showing the results. A liberal number of illustrations are scattered throughout.

* * *

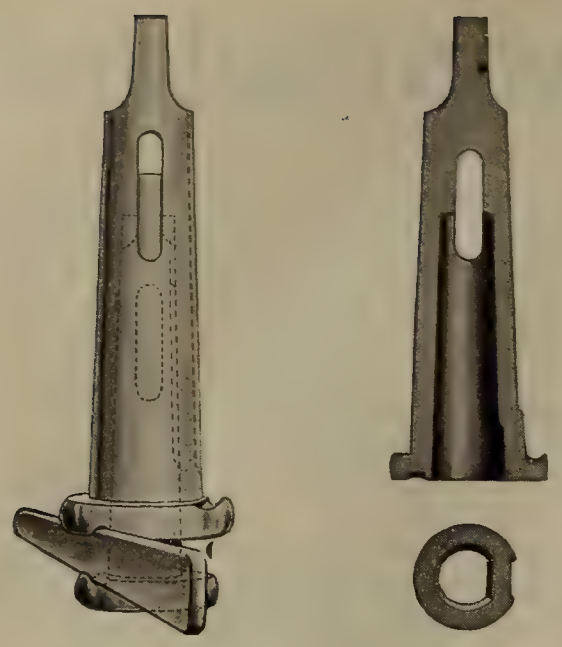
A catalogue of Homestead valves has recently been issued by the Homestead Valve Mfg. Co., of Homestead, Pa. In it is shown a large assortment of these well known valves.

* * *

The Independent Pneumatic Tool Co., of Chicago, has issued a large and comprehensive catalogue of Thor pneumatic tools which include drills, flue rollers, grinders, hammers and staybolt drivers. It is bound between heavy covers and is well arranged in every way. A large number of illustrations showing Thor air tools in actual use in locomotive shop, are given. The same firm has also recently issued a special booklet on stone cutting tools.

WEAR-EVER DRILL SOCKET.

A new drill socket has been brought out by Scully, Jones & Co., of Chicago, called the "Wear-ever." It is made of a special steel, heat treated, hardened and ground, and is of standard taper, both inside and out. It will be noted in



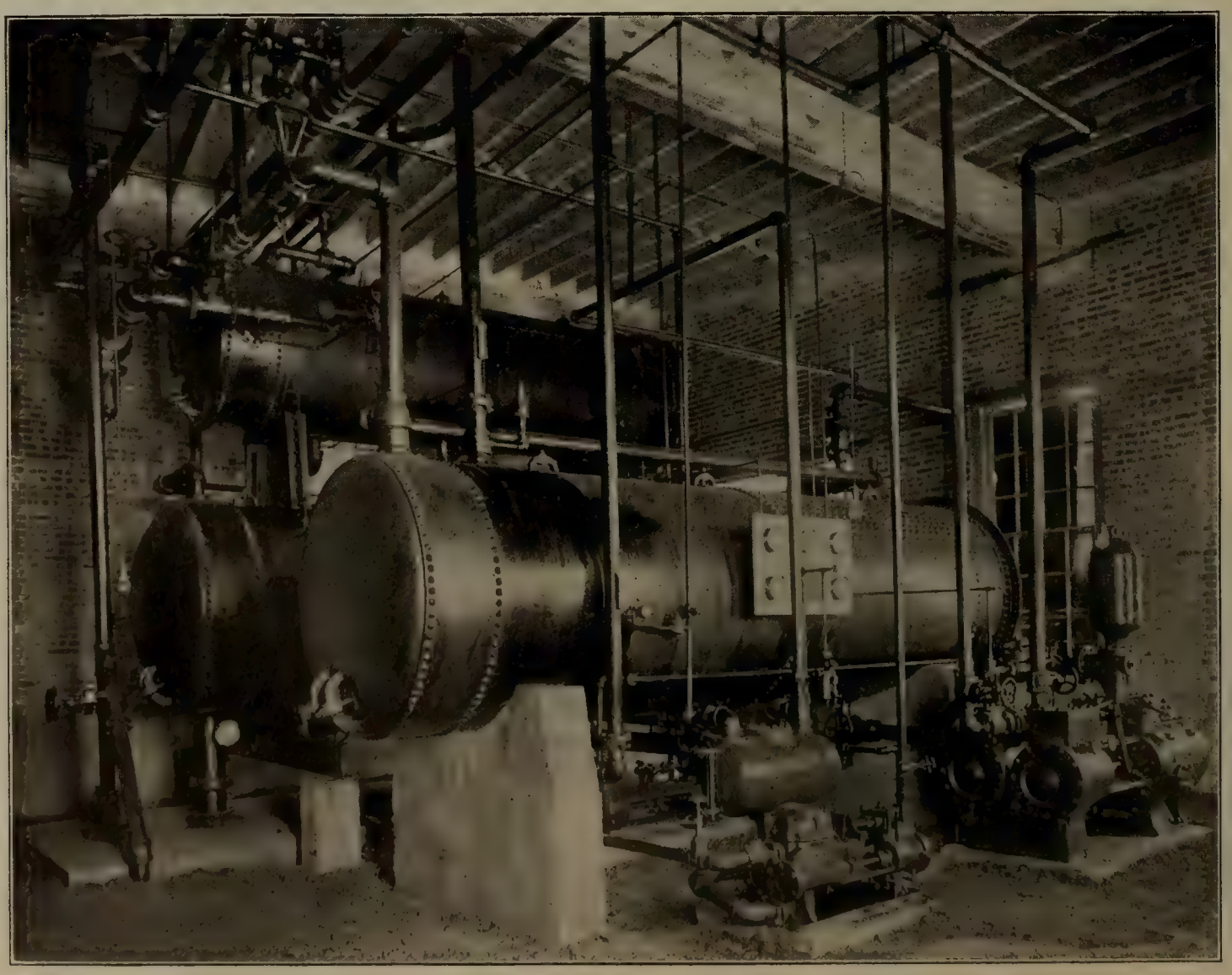
Views of the Wear-ever Socket.

the illustration that there is an inner key and an outer keyway which is of considerable advantage inasmuch as it distributes the strain evenly on the sockets. The socket has a collar, a reinforcement around the base, which greatly strengthens it at a point where it is needed as it is quite common for most sockets to flare at the base after heavy usage. This collar also provides a means of separating nested sockets with a considerable saving in time. That is, with the ordinary socket, if a bunch of them are nested, it is necessary to start at the top and separate the sockets one at a time until the desired one is reached. With the "Wear-ever" sockets, the holes for inserting the drift are not covered up but are on the outside and the drift can be immediately inserted between any two sockets. They can be nested with any socket made and drills can readily be adapted to them by grinding a flat on the shank.

HOT WATER BOILER WASHING SYSTEM.

A number of installations of hot water boiler washing and filling systems have recently been built by the Cowles-MacDowell Engineering Co., of Chicago. Their system works on an automatic vacuum principle of the closed type and enables higher and more constant water temperature to be maintained. It also insures a more constant circulation and enables all condensation to be delivered to the heaters.

The arrangement of the heater and tanks is shown in the illustration. Blow-off water and steam pass first into the blow-off basin, from this basin the steam passes to the first end compartment of the main heater, then through the tubes to the opposite end compartment of the main heater. Condensation, resulting from the steam imparting its heat to the refilling water surrounding the tubes, is discharged into the main heater, where it adds to the quantity and heat of the refilling water. Clean water for refilling is taken from the railroad company's supply, passed through the main heater, where its temperature is raised by the blow-off steam; from the main heater the refilling water passes to the reciprocal heater, where its temperature is raised to 180 deg. and above, and then goes to the round house. The heat for raising the temperature of refilling water in the reciprocal heater is that from the exhaust steam principally, supplemented by the surplus blow-off steam and by live steam at times when there would be a deficiency of exhaust and blow-off steam. Steam enters one end compartment of the reciprocal heater, passes through the tubes and imparts its heat to the refilling water surrounding the tubes and is condensed and discharges into the other end compartment of the reciprocal heater and from there it is conveyed to the main heater, adding an additional amount to the quantity and heat of the refilling water. From the end of the refilling line there is a return line to the reciprocal heater which completes loop for circulation; or when a separate refilling pump is installed circulation is maintained through the automatic circulating valve on pump.

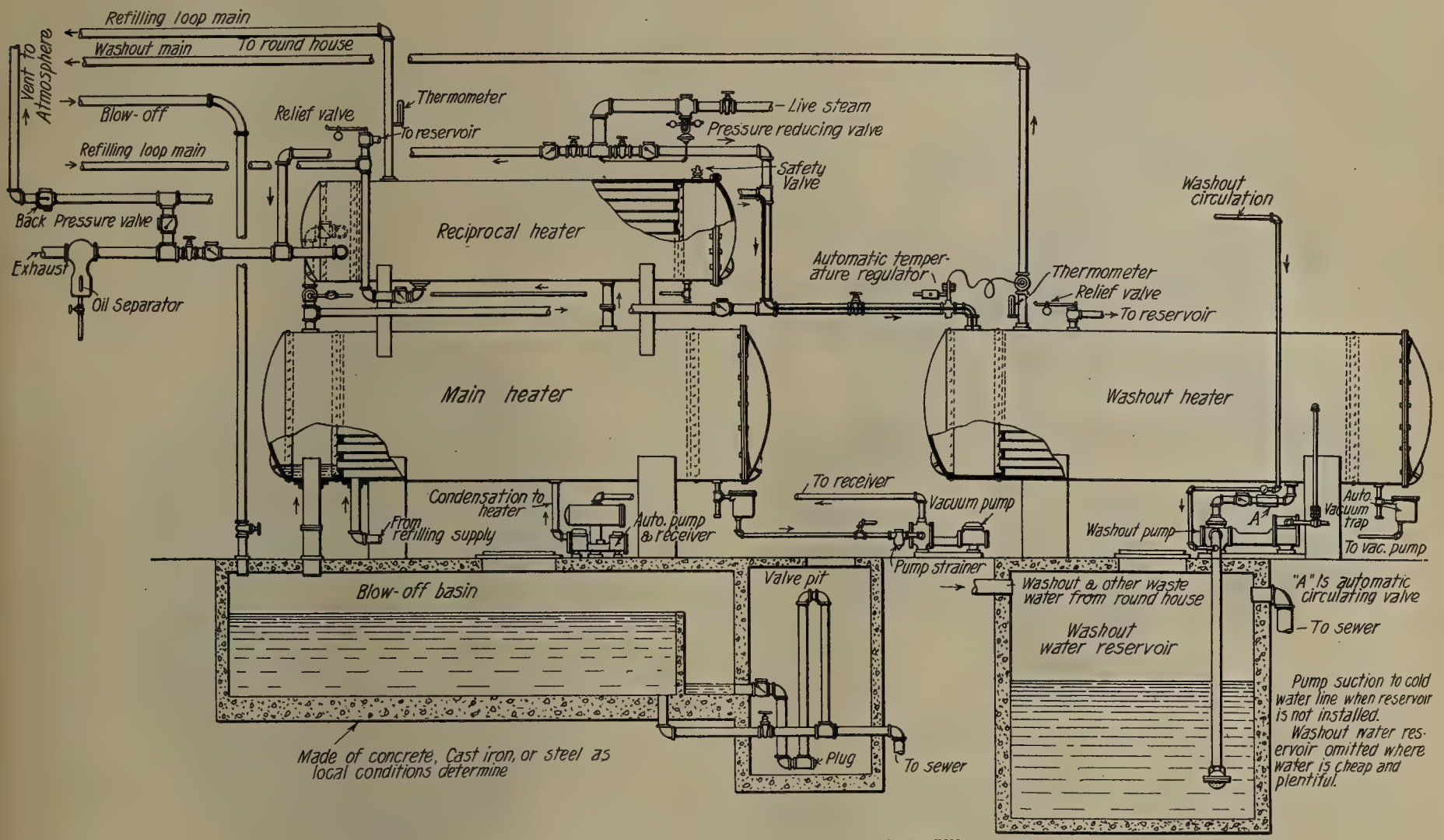


Cowles-MacDowell Boiler Washing and Refilling Installation at Council Bluffs, Ia., C. & N. W. Ry.

Blow-off products are held in the blow-off basin, where the heat is extracted under a vacuum in the form of a vapor, which passes into the main heater, as described above, after which the dirty water passes to the sewer through the siphon in the valve pit, the sludge can be washed to the sewer through a sludge pipe in the bottom of the basin, or removed through manhole. The objects of the siphon are to seal the basin for insuring a vacuum therein and for discharging the dirty water to the sewer. The washout pump takes its supply from the washout reservoir and passes it through the washout heater, where its temperature is raised by the heat from exhaust steam, surplus blow-off steam and live steam which circulate through the tubes in the heater. Live steam is used only when there is a deficiency in the other heat supplies. The temperature of the washout water is maintained at about 130 deg. by means of a Sylphon temperature regulator. Circulation is maintained through the automatic circulating valve on pump. The water used for washing out returns to the washout reservoir. The vacuum pump maintains a vacuum in the tubes and end chambers of the washout heater which insures efficient circulation of steam through same. The condensation from the washout heater is discharged into the main heater.

The vacuum pump maintains a vacuum in the end compartments and tubes of the main heater, the blow-off basin, and the blow-off main to the valves on the lower ends of the post drops. While the vacuum in the blow-off main is destroyed when engines blow-off, the back pressure against the blow-off steam and water is practically destroyed by the counter effect of the vacuum, thus insuring material reduction in the time of blowing off, particularly at the later end of blowing off when the steam pressure is low. The vacuum is the means by which the blow-off steam is passed into the heaters. The vacuum pump discharges all condensation into an automatic pump and receiver, which discharges into the main heater.

Globe, check, pressure relief, and other valves are set in the pipe lines for the usual purposes, and a vent pipe with a back pressure valve set at about 5 lbs. leads to the atmosphere and constitutes the main relief or safety valve. The pumps are controlled by governors in the usual way. The heaters are built for 135 lbs. working pressure. The plant is practically automatic in operation and constitutes a continuous feed water heating system.



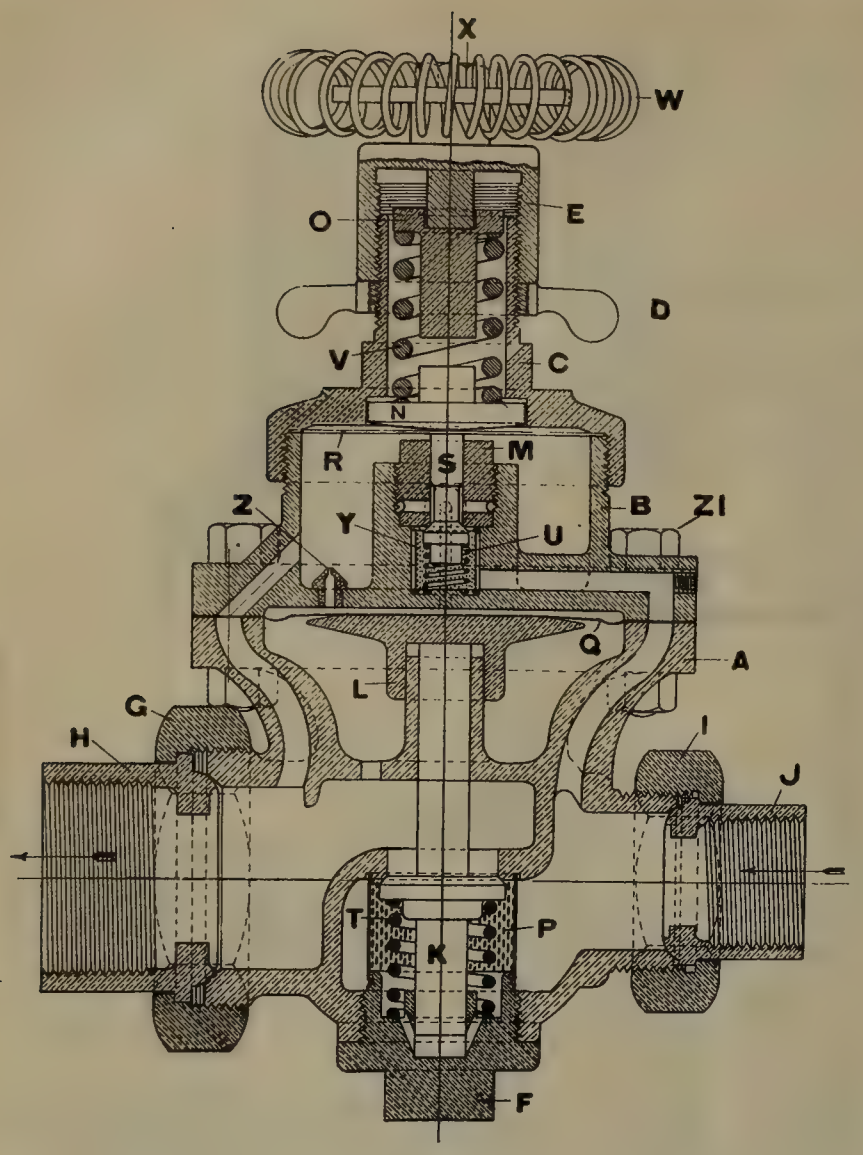
Arrangement of Cowles-MacDowell Boiler Washing and Refilling Apparatus.

TESTS OF TRAIN HEATING SYSTEM PRESSURE REGULATOR.

The following is an account, by Arthur M. Waitt, consulting engineer, of a test, made by him, on the "Gold Ideal" pressure regulator made by the Gold Car Heating & Lighting Co., New York:

On Monday, February 19th, 1912, I made a severe test of the operation of the "Gold Ideal" pressure regulator in the yards of one of the large railway systems running out of New York.

The regulator was applied to a standard passenger locomotive, which was then coupled to a train of five average sized modern passenger coaches. A steam gauge was connected with the train supply pipe from where it was attached to the regulator and it constantly indicated the pressure maintained at that point. After coupling the steam hose between all the coaches steam was furnished to the train pipe, as far back as the rear of tender, by opening the regulator sufficiently to furnish a pressure of 30 lbs. on the train supply or outlet side of the regulator. With this setting of the regulator steam was admitted first to the train pipe and radiating pipes of the coach next to the locomotive. After waiting several minutes until steam showed at the drip on this coach the steam was admitted to the train and radiating pipes of a second car and it in turn was heated until steam showed at the drip. Next three more coaches were at once added to the train being heated. After allowing steam to be on the entire five cars for over five minutes



Sectional View of Gold Ideal Pressure Regulator.

the hose on the rear end of the rear coach was fully opened allowing steam to blow freely from train pipe. After allowing the rear hose to be open full for two minutes, the cars were all cut off at once by closing the cock on the front end of first car.

The next test was the severest possible one. The hose connection was broken between the tender and first car and steam at full supply pressure allowed to freely pour out from tender hose.

During all of the above changes in the demand on the locomotive steam supply, no readable variation could be noted on the train supply gauge on the locomotive, from the 30 lbs. at which the regulator was set. The only noticeable movement in the gauge hand was when the rear hose on the trains, and the rear hose on the tender were opened full for steam to blow out. In these instances a slight unmeasurable vibration of the gauge hand was produced, showing the rapid alternate slight opening and closing of the controlling valve in the regulator.

As a final trial the regulator was set to furnish a pressure of 40 lbs. and the hose on the rear of the tender left wide open. With this severe trial the supply pressure at the train supply side of regulator was maintained absolutely steady. During the tests the locomotive boiler pressure varied between 200 and 205 lbs. but this variation produced no effect on the train supply pressure furnished.

In brief the result of my examination and testing of the Gold Ideal Regulator showed that under the simplest and under the most severe and adverse conditions this regulator delivered steam for the train supply pipe at uniform and fixed predetermined pressure.

Operation of Regulator.

The operation of the Gold Ideal Pressure Regulator is readily understood by reference to the sectional view herewith.

By screwing down handle W until V is sufficiently compressed to allow the required and predetermined delivery pressure to be furnished at the outlet side of regulator (left hand side), the controlling valve is opened. Steam at boiler pressure comes into the inlet side of regulator (right hand side) and passes up through the small passage to the space under bottom of the controlling valve and through the open valve to a small annular groove above valve and thence through a small connecting passage (shown in dotted lines) downward to the space above the large diaphragm Q. The pressure exerted on this diaphragm presses it downward, opening the main supply valve, thereby admitting a flow of high pressure steam from the inlet to the outlet side of the regulator, the steam at the same time passing upward, through an opening provided, into chamber under main diaphragm Q, and also upward through small passage into the chamber under the controlling diaphragm R, presses against these diaphragms until it just balances the pressure exerted on their upper sides. If the draft on the steam on the low pressure side of the regulator is increased, it tends to reduce the pressure there. This reduction of pressure is at once transmitted to the under side of the controlling diaphragm R and the fixed compression in the spring V at once causes this diaphragm to depress and the controlling valve is opened, thereby allowing high pressure steam to pass through this valve to the top of the main diaphragm Q producing a further opening of the main supply valve and an immediate increase of the supply of high pressure steam directly to the low pressure side of the regulator. If for any reason the supply or boiler pressure is reduced, the resultant pressure on the outlet or train supply side of regulator would be momentarily slightly reduced and the consequent pressure in chamber under the controlling diaphragm R would be lessened and at once the controlling valve would open slightly, thereby in its turn causing the main supply valve to open farther and give the added volume and pressure from the boiler supply side necessary to keep the train supply side up to the predetermined pressure.

If, from any cause, the pressure on the train supply side of regulator is increased, as might be produced by a reduction of number of cars to be supplied with steam, the increased resultant pressure on the under side of the main diaphragm Q would at once cause main valve to close and at the same time this increased pressure under the controlling diaphragm R would hold the controlling valve tightly closed until such time as the pressure on the train supply side of regulator was reduced to a point below the predetermined train supply pressure.

The controlling valve will always be closed when the train supply pressure reaches the predetermined amount, and will at once be opened automatically when it reduces below this amount.

In case of any small leakage of steam through the controlling valve to the space above the large diaphragm, such leakage will pass through the small leakage plug opening at Z into the train supply side of the regulator, thereby causing no opening movement of the main supply valve.

Industrial Notes

The Moore Locomotive Ashpan Co., Montgomery, Ala., has been incorporated with a capital of $32,000.

The Westinghouse Electric & Manufacturing Co., has purchased an eight-wheel, radial truck, steam locomotive crane with a lifting capacity of 15 tons. The locomotive will be used for excavating, dredging Turtle Creek and handling coal.

The American Steel Foundries Co. will improve its shops

for making the Davis car wheel. About $140,000 is to be spent for improvements.

The Joseph Dixon Crucible Company of Jersey City, has just put on the market a new chain graphite, especially intended for lubricating the chains of motor trucks and pleasure cars.

Mr. C. C. Owens has recently been placed in charge of the Detroit Sales Office of the Westinghouse Co. with the title of district manager. For the last eight years he has been connected with the New York Sales Office, having had charge of the Industrial and Power division for the two previous years to his transfer to Detroit.

S. T. Fulton, former assistant to the president of the Rock Island, has been appointed general sales agent for the Railway Steel Spring Company. Mr. Fulton's office will be in New York.

S. T. Fulton.

Judge Day of the United States district court at Cleveland on March 4 rendered an opinion dismissing the suit of the Railroad Supply Company against the Elyria Iron & Steel Company for alleged infringement of the Wolhaupter patents on railway tie plates.

Frederick Maley, formerly with the Baldwin Locomotive Works, Philadelphia, Pa., has been made superintendent of the oxy-acetylene department of the Alexander Milburn Co., Baltimore, Md. The Milburn company has recently equipped several locomotive cranes for the Maryland Steel Co., Sparrows Point, Md., with its new steam acetylene generator, which utilizes waste steam from the boiler, operating a number of searchlights and allowing night work to be carried on satisfactorily.

The Lansing Co., of Lansing, Mich., recently purchased the entire hoist building plant of the Butcher & Gage Co., Jackson, Mich., and in the future will manufacture "Wolverine" hoists in Lansing.

The John F. Stevens Co. has been incorporated under the laws of the state of New York, U. S. A. It will execute by contract, or supervise, under any terms that may be mutually agreed upon, the construction of railways—whether steam or electric, canals, river and harbor improvements, irrigation projects, water power developments, etc.

Philip H. Ryan has resigned his position in the mechanical department of the New York Central & Hudson River to enter the railway department of the American Steam Gauge & Valve Manufacturing Co., Boston, Mass.

Mr. H. R. Setz, who has been chief engineer of the Struthers Wells Co., of Warren, Pa., has accepted the position of chief engineer with the Otto Gas Engine Works of Philadelphia.

The United States Steel Ry. Tie Co., with offices in the Oliver building, Pittsburg, is arranging for the location of a plant in the Pittsburg district through the Pittsburg Industrial Development Commission. R. E. L. Maxey is manager of the company.

The Bucyrus Co., South Milwaukee, Wis., has taken over the manufacture of the Atlantic type shovel, heretofore built by the American Locomotive Co., and it is the expectation of the company to continue to build all of the sizes previously built, and to eventually have a complete line of Atlantic wire-rope shovels, in addition to a complete line of Bucyrus chain-type shovels.

Cornell S. Hawley, formerly president of the Consolidated Car Heating Co., Albany, N. Y., has been made president of the Laconia Car Co., Boston, Mass. The Laconia Car Co. was recently organized to take over the Laconia Car Company Works. The company is capitalized at $2,000,000, consisting of $1,000,000 7 per cent cumulative preferred stock and $1,000,000 common stock.

R. T. McCormick has resigned as manager of sales of the Petroleum Iron Works Co., Sharon, Pa. C. J. McDowell has been appointed to succeed him.

The Safety Car Heating & Lighting Co., Jersey City, N. J., has awarded a contract to the Turner Construction Co., 11 Broadway, New York, for the erection of a factory building at Twelfth street. The building will be 100x100 ft. in area, five stories, and will be completed in about four months.

Scully-Jones & Co., Chicago, have been made exclusive agents in Illinois, Indiana, Iowa and Wisconsin for Elco high-speed steel, made by Vickers Sons & Maxim, Sheffield, England.

The H. K. Porter Locomotive Co., Pittsburg, Pa., has awarded contracts to the Pittsburg Construction Co., and the American Bridge Co., for the addition of two manufacturing buildings to the Lawrenceville plant. The improvement involves an expenditure of $100,000.

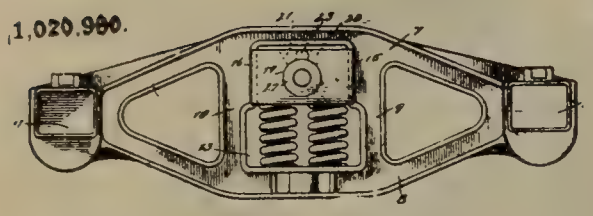
The Pennsylvania Tank Car Co., of Sharon, Pa., has awarded the contract for the erection of a building, 250x40 ft. in area. When this improvement is completed the company will have doubled the capacity of its plant.

The McKeen Motor Car Company has recently opened an office in the Hudson Terminal Building, 30 Church street, New York City, and has appointed Mr. Stephen D. Barnett as eastern representative.

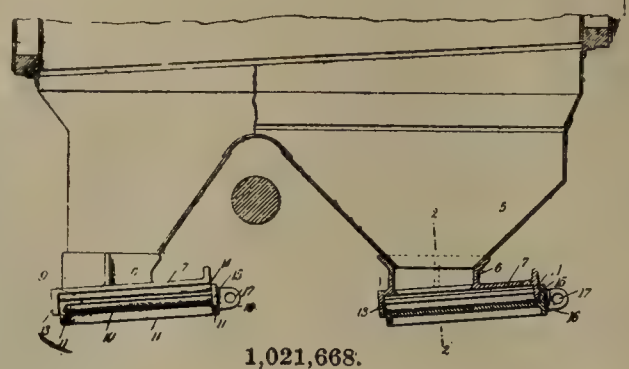
Stephen D. Barnett.

Recent Railway Mechanical Patents

1,020,980.



1,021,668.



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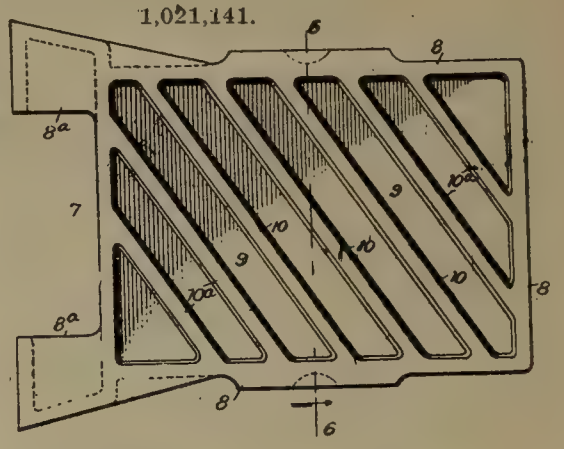


LOCOMOTIVE ASH PAN.

1,021,668—James F. Dunn, Salt Lake City, Utah.

There are oppositely disposed guide members at the sides of the hopper each having two parallel flanges, one over the other with the upper flangs extending outwardly beyond the lower flanges. At the sides of the device is a door for closing the hopper having faces placed against the bottom of the lower flanges, and side members disposed at the outer sides of the lower flanges. These are covered by the upper flanges, and have inwardly extending bearing flanges on the side members for traveling between the flanges on the guide members. There are two members spaced apart and depending from the hopper, one of which serves to prevent the ashes from falling off the door when the door is closed, and the other serving to push the ashes off the door when it is opened.

HYDROCARBON-BURNER.

1,020,612—Robert W. Lawton, San Francisco, Cal.

The bonnet is of double conical shape and has a series of spirally arranged grooves. The steam and oil pipes are attached to the bonnet in the form of a nozzle; the steam pipe surrounding the oil pipe. There are a series of holes in the nozzle for the discharge of the steam and also a series of inclined holes for the admission of air.

DIES FOR CUTTING THREADS.

1,020,996—Milton H. Lukens, Marblehead, Mass.

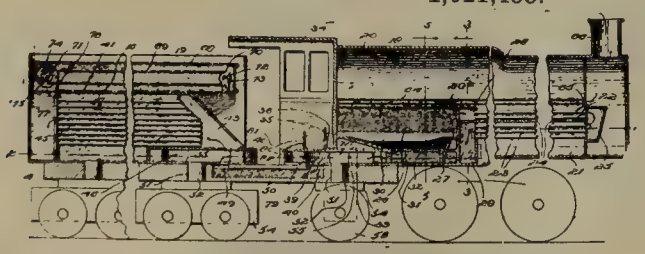
A combination of two rotatable thread cutting dies centrally pivoted to sliding blocks placed opposite each other. These dies are adapted to cut two or more threads of different pitches, and have two or more keyways cut around their central holes, pivot pins for pivoting said dies and tapering keys fixed thereto. They are adapted to enter said keyways, with sliding blocks one portion of which is above and one portion below the dies. Two or more keyways are cut around the central hole and adapted to receive said pivot pins and their taper keys.

LOCOMOTIVE.

1,021,455—Thomas R. Dawson, Barnesboro, Pa.

A locomotive boiler which has upper and lower sets of conducting passages for the heated gases. The heat passes first through the upper passage thence through the lower ones to a chamber. The water tank in the tender is divided into a number of heat conducting compartments and heat may be passed from the above mentioned chamber to the flues in the water tank. Dampers are provided for regulating the passage of heat.

1,021,455.



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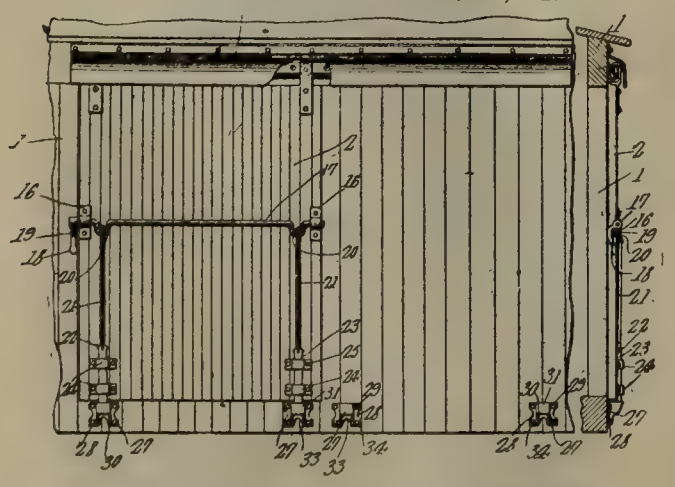

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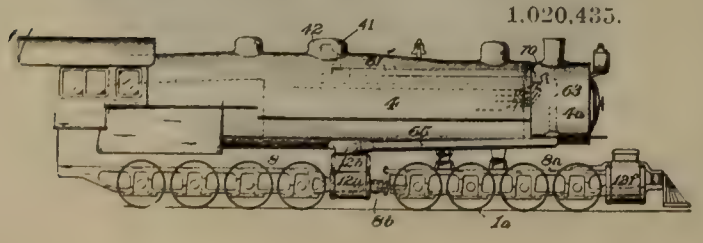

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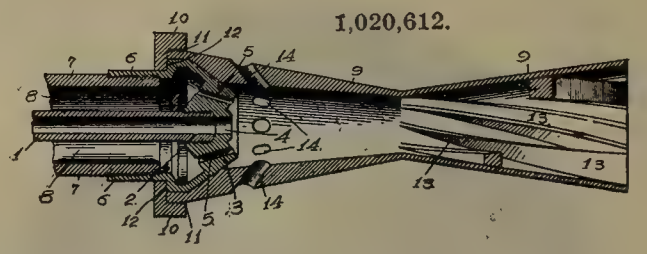

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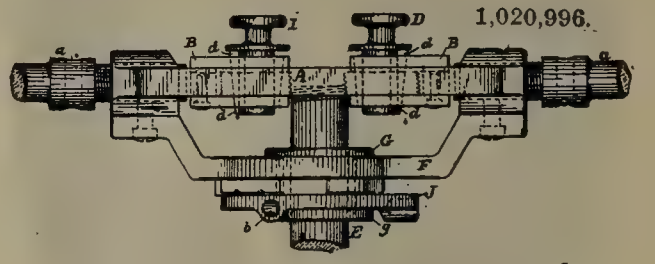

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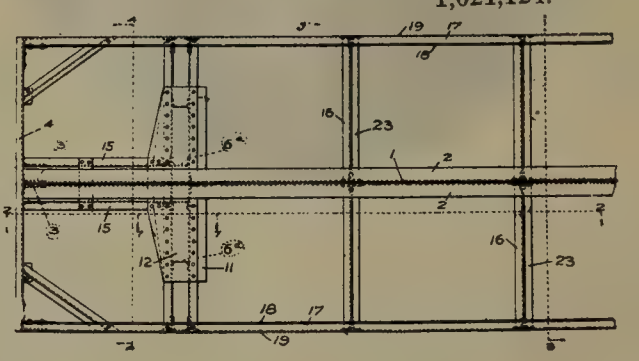

CAR UNDERFRAME.

1,021,124—Herbert W. Wolff, St. Louis, Mo. Assignor to the American Car & Fdy. Co., St. Louis, Mo.

The underframe consists of a combination of continuous bolster, a single plate girder sill, the web of which terminates in the vicinity of said bolsters, and the compression flange of which extends beyond the bolsters. The body bolster is continuous and consists of channel shaped diaphragm members.

CAR-DOOR FASTENER.

1,020,435.

A vertically swinging, sliding door which is held in place by bolts which are attached to a shaft across the middle of the door. At one side of the door are other projections for receiving the locking bolts when the door is open.

STEAM PIPE FOR ARTICULATED LOCOMOTIVE.

1,020,435—Carl J. Mellin, Schnectady, N. Y.

The steam pipes extend downwardly through the smoke box and lateral steam pipes extend from thence, outside and alongside the boiler to the cylinder. These pipes contain expansion joints.

CAR TRUCK CONSTRUCTION.

1,020,960—Joseph W. Bettendorf, Bettendorf, Ia.

The side frame containing the bolster has a bearing which is movably supported. The bolster has a limited rotative connection but is held against any longitudinal movement with respect to the side frames.

JOURNAL BEARING WEDGE.

1,021,141—Robert E. Frame, St. Louis, Mo.

A wedge comprising a body provided with obliquely disposed integral ribs upon opposite sides, some of the ribs on one side extending entirely across said wedge and some of said ribs extending only across the median line of said wedge.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

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WATER TREATMENT.

On another page we publish an extract from a paper on the subject of water treating, which was read before the Western Railway Club, April 16, by W. A. Pownall, water engineer, Chicago, Burlington & Quincy R. R. After a short general description of the water treatment by the plant method in which both carbonates and sulphates of lime and magnesia are removed, he considers principally the sodium carbonate or soda ash reaction in the boiler. He shows how, by the addition of certain quantities of sodium carbonate, a reaction is made to take place which decomposes the scale forming sulphates in the water, resulting in mud forming carbonates which go to swell the amount of carbonates already in the water, and in sodium sulphate which stays in solution.

By this method he gets rid of the most of the scale forming substance in the water, but has produced a condition, which unless intelligently handled, frequently causes more trouble than that obviated. The treated water in the boiler gathers more and more soluble sodium sulphate as the engine goes over the division until it reaches a high state of concentration which with suspended organic and mineral matter causes foaming. Meanwhile the quantity of sludge which would naturally be precipitated from the water is increased by the carbonates precipitated the reaction of the treatment. Mr. Pownall states that the only means of getting rid of this concentration is by blowing down. He then proceeds to show how the blowing down may be taken care of by arranging a miniature blow off pipe which is supposed to keep down the concentration by drizzling water over much of the run. This method takes care of the concentrated alkali water but he seems to forget the mud in the bottom of the boiler, for part of which he is responsible.

It is to be presumed that the difficulty in getting good results by depending upon enginemen to properly blow down their boilers, is responsible for the "drizzle pipe" suggestion. All motive power officials have frequently met with this same problem. In the interests of safety and economy, in bad water districts, freight locomotive boilers must be blown down between terminal with more or less frequency where the soda ash treatment is used. This practice sometimes brings strong protest from operating and maintenance of way department officials, however. The "drizzle pipe" would not excite this protest but neither would it clear the boiler of the sludge, the disposal of which is a good part of the mission of the blow off.

It would seem that the location of a blow off box at yard switches and at water tanks might be a means of obviating the difficulty, owing to the fact, however, that at such points the locomotive would be idle and the circulation within the boilers not good. This is not an ideal system to follow. A plan which could reasonably be expected to overcome these objections would be a blow off pipe carried to a point between the frames under the deck casting and there fitted with a baffle box arranged to drop the water without strong ejection force, between the rails. This would not, however, overcome the difficulty of getting the engine men to perform the duty of blowing off frequently and it is

doubtful if any practice which depends upon the thorough co-operation of the engine men in this detail, will be successful. The complete treatment of the water before it reaches the boiler seems to be the logical means to the end desired. The comparative success of other railways besides the Burlington in the system described by Mr. Pownall is, however, proof of the fact that a great deal can be gained by the soda ash treatment alone. Close supervision is the key to the situation.

OMAHA SHOPS.

To the credit of the management of the mechanical department of the Union Pacific, the effects of the recent strike of machinists and other employees of the department has apparently passed into history. This strike, called on all of the Harriman lines, took nearly every man out of Omaha shops. By careful hiring, the gangs were gradually made up of new men until the output became perhaps 75 per cent of normal. Soon a few old employees, expert in their lines, drifted back until with a smaller number of men the output is said to have gone to over 100 per cent of what has been considered normal, working hours taken into consideration.

A feature of interest in connection with the new gangs is the large number of very young men who are acting as machinists. This is due to the fact that the large number of apprentices and helpers who were not members of the various unions were willing to accept employment. They were given special attention and instruction until in a surprisingly short time they were given charge of machines. This has reduced payrolls while at the same time it has increased the amount of work per hour man.

Previous to 1909, the Omaha shop was not a model of convenience in its machine tool layout. The machines were crowded until the work of many men was seriously hampered. Three years ago the master mechanic in charge, Geo. J. Hatz, finding it absolutely necessary to use more machines, conceived a new layout entailing a complete rearrangement. The task was a large one, but it was undertaken and carried through with the result that no less than twenty-one more machines than were taken out are now in service. Moreover, there is now no impression of a crowded condition. All passageways have right angle turns facilitating trucking; the movement of material is such that there is no confusion, and there are no blockaded passageways due to lack of storage room at the heavy machines. Such machines as can be placed close together without impedance of their operation are so located. Large machines are situated where plenty of room can be had for their operation. Cranes, both jib and traveling, are now used to the very best advantage. These advantages have been obtained to a considerable extent by making use of individual motor drive. In short, we believe the Omaha shops to be nearly the last word in excellence of arrangement, considered from the standpoint of space economy.

The Philadelphia Foundrymen's Assn. held its 218th meeting at the Hotel Walton, Philadelphia, Pa., May 1, 1912. An illustrated lecture by John Birkinfine and a banquet were features of the evening. Prominent members of the Association were speakers.

SIGNS.

The lack of signs is wonderfully conspicuous at some mechanical department offices and shops. We have gone to some shops and after carefully feeling our way along the fence have found a small opening which apparently was the main entrance. Once inside one is perhaps face to face with a fine side view of the foundry and after getting around the end one may be fortunate enough to run across an employee. Upon being asked where the master mechanic's office is the chances are that he will point over his shoulder with his thumb and say "down there." After a few more inquiries the building is located and even then one may not be sure whether he is going in at the back door or the front door. When he has invaded a few offices on the first floor he may discover that the master mechanic's office is on the second floor.

Contrast this with some other offices. One walks down along the fence on a well kept walk and comes to a big jog in the fence. It leads into the grounds and up to a building on which a sign says "Master Mechanic's Office." Entering the building one is in a hall upon which a number of doors open. These doors are neatly labeled and there is no difficulty in getting in touch with the office sought for.

Now it is true that some shops are more fortunately situated than others and some have the advantages of modern construction and layout. However, even in plants which are not so well arranged, three or four well placed signs and perhaps a side-walk would give a much better impression and would make it much easier for visitors. And let names be placed upon the doors of offices. Certainly the title "Master Mechanic" is one to be proud of. It may be that the lack of direction is to discourage the entrance of visitors. The man with no legitimate business can quickly be handled by the chief clerk; the man who has business will find his way even if it does waste his time and the time of employees, whom he has to stop to ask his way. A master mechanic has many visitors during the course of a year, many of whom are unfamiliar with the layout of the shop and who are deserving of consideration.

MISTAKES OF MECHANICAL OPERATING OFFICIALS

One benefit to be gained by the use of the Hine system of organization is the extension of the jurisdiction of the division mechanical and engineering official to include operating problems. The operating officer is often a man with little conception of mechanics and his anxiety to keep the wheels turning, sometimes plays havoc with equipment.

In times of snow blockades these cases most frequently come to attention. Division operating officials are frequently driven to desperation by operating difficulties and mistakes of judgment at such times, do not deserve the condemnation they should otherwise receive.

An instance in point was described recently by a master mechanic. A branch line had been blocked for several days and a rotary plow with two engines was sent to clear the line, the train became wedged in a drift and only the rear engine could be backed out. Both master mechanic and division superintendent were with the outfit. The superintendent ordered the second engine cut off, backed up, for the purpose of ramming the first engine and plow through the drift. The objections of the mas-

ter mechanic were useless and as the engine men were under the jurisdiction of the superintendent nothing remained for them but to obey. It may be that they took more of a run than the superintendent intended, for the resulting smash up was greater than even the master mechanic expected.

On another page of this issue are shown photographs of a snow bucking outfit both before and after the inevitable accident which followed its attempt to clear the line. Six heavy freight engines coupled together compose, with the cabooses, a ram of such power that any obstruction must either be cleared away or an accident must happen. In this case it was the latter. It is not reasonable to suppose that any mechanical official would make himself responsible for valuable equipment by ordering it used in this way even if he were in authority.

It is in such cases as this that we may expect benefit from the Hine organization. Had this system been in effect in the instances mentioned, no such errors of judgment would have been permitted. As the mechanical official is on an equal footing in authority with the operating and engineering officials of like grade, anywhere on the property of the railway company.

MANY IDEAS are suggested to the mind in more or less hazy form during the course of a man's daily routine. The trouble is we don't make it a comfortable place for them to stop and hatch out. An idea flits in, but the next minute the mind is turned to another matter and the idea has left again. If we could make captives of but half of these hazy ideas and develop them to a state where we could tell if they are practical, it would be of great benefit to us. A small note book and pencil aways at hand is a very good thing to put these suggestions in until they can be given more time.

* * *

THE RAILWAY TAX MEN'S Association was recently organized in Chicago. One of its chief objects is the consideration of assessment and tax questions in various states and to endeavor to bring about more uniform practices throughout the country with respect to assessments. The membership is at present composed of the representatives of twenty-five roads.

Pacific Type Engines, Grand Trunk Ry.

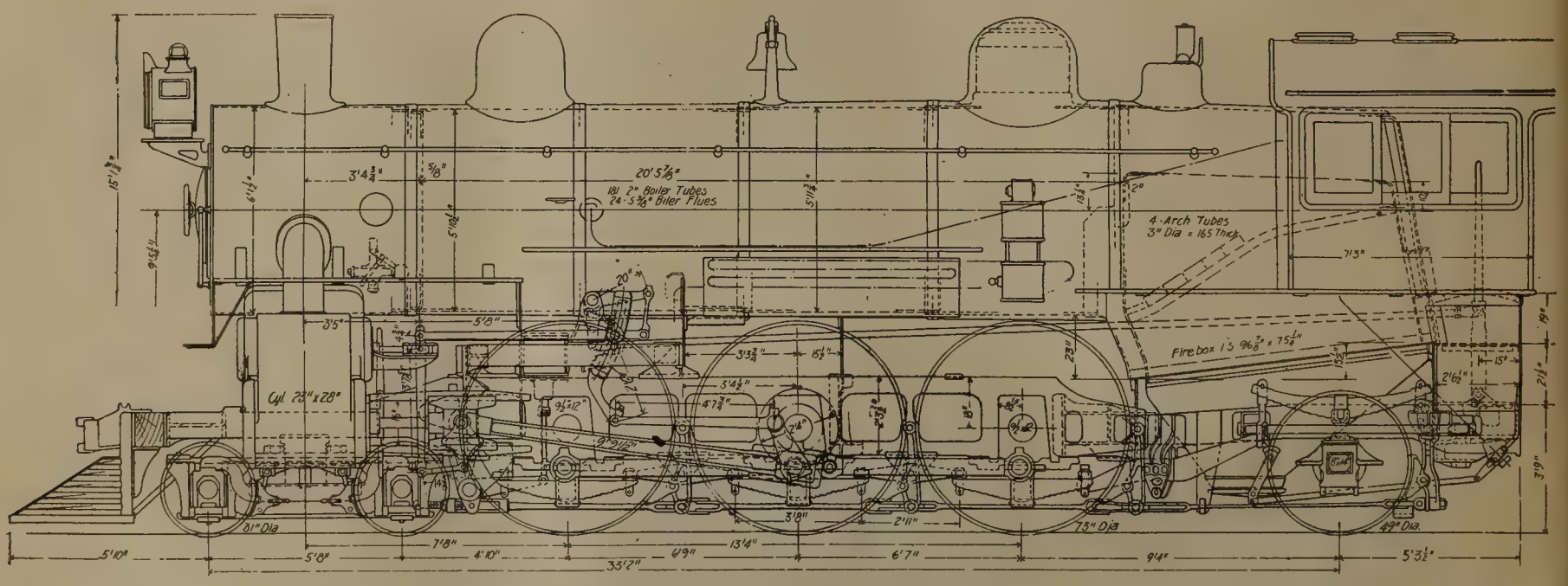
The Grand Trunk Railway is constructing a number of Pacific type engines at its Montreal shops to be known as class P, which are being equipped with Schmidt superheaters and Walschaerts valve gears and are in some respects quite similar to the Pacific's built by the C., M. & St. P. Ry. and described in the March issue of *Railway Master Mechanic*. Eight superheater engines of the straight top type are being built. These will have 181 two inch tubes 20 ft. 7 in. long and 24 5⅜ in. tubes for the superheater units, which together with the firebox heating surface of 169 square feet will give a total heating surface of 2,803 square feet, exclusive of the superheater pipes. The grate area is 50.62 square feet, and the working pressure 185 pounds. Cylinders are 23x28 in., with 14 in. piston valves, and in accordance with the best and latest practice, outside steam pipes are used. Detroit lubricators are used on the valve gear. Superheat oil is introduced to both valves and cylinders. The engines are equipped with wide, inclined bottom fireboxes and are equipped with brick arches and fire-door openers. Side frames are of cast steel, having a width of four inches. The tender is of the water bottom type, having a capacity of 8,000 gallons of water and ten to fourteen tons of coal. The tender underframe is built of 10 inch channels and the Cole trailer truck is used. The new engines have a tractive force of 31,900 pounds as compared with the 31,560 pounds of the present Pacifics. The heating surface of the old Pacifics is 3,509 square feet, while that of the new engines is 2,803, exclusive of the superheater pipes. The arrangement of the superheater and smoke box, and also the cylinder castings is practically the same as those of the C., M. & St. P., illustrated in the March issue. The photographic illustration shows the present type of the Pacific engine, which is practically the same as the new engines except for the superheater.

Present Pacifics of the Grand Trunk.

Two engines of the present Pacific type are being built and these are being fitted with 22x28 in. Hobart-Allfree cylinders. The boiler for these engines will have 305 two inch tubes 20 ft. 7 in. long giving a heating surface of 3,340

square feet. The working pressure for these engines is 200 pounds. Following is a table of weights, dimensions and ratios for the superheater engines:

Gauge	4 ft. 8½ ins.
Cylinders	23x28 ins.
Valves	Piston
Boiler—	
Type	Straight top
Material	Steel
Diameter	70½ ins.
Working pressure	185 lbs.
Fuel	Coal
Fire Box—	
Material	Steel
Length	96⅞ ins.
Width	75¼ ins.
Thickness of sheets, sides	⅜ in.
Thickness of sheets, back	⅜ in.
Thickness of sheets, crown	⅜ in.
Thickness of sheets, tube	½ in.
Water Space—	
Front	5½ ins.
Sides	4½ ins.
Back	4½ ins.
Tubes—	
Diameter	5⅜ and 2 ins.
Material	Steel
Number	5⅜ in., 24; 2 in., 181
Length	20 ft. 7 ins.
Heating Surface—	
Fire Box	169 sq. ft.
Tubes	1,942 sq. ft.
Superheater flues	692 sq. ft.
Superheater pipes	
Total	2,803 sq. ft.
Grate area	50.62 sq. ft.
Driving Wheels—	
Diameter, outside	73 ins.
Diameter, center	66 ins.
Journals	9½x12 ins.
Engine Truck Wheels—	
Diameter, front	31 ins.
Journals	6½x10⅜ ins.
Diameter, back	49 ins.
Journals	8x14 ins.
Wheel Base—	
Driving	13 ft. 4 ins.
Rigid	13 ft. 4 ins.
Total engine	33 ft. 2 ins.
Total engine and tender	72 ft. 9 ins.
Weight—	
On driving wheels	145,000 lbs.
On truck, front	40,000 lbs.
On truck, back	38,000 lbs.
Total engine	223,000 ibs.
Total engine and tender, about	367,660 lbs.
Tender—	
Wheels, number	8
Wheels, diameter	34 ins.
Tank capacity	8,000 gals.
Fuel capacity	10 to 14 tons
Service	Passenger
Ratios—	
Weight on drivers ÷ tractive power	4.54
Total weight ÷ tractive power	6.33
Tractive power × diameter drivers ÷ heat surface	831
Total heating surface ÷ grate area	55.3
Firebox heating surface ÷ total heating surface, per cent	6.03
Weight on drivers ÷ total heating surface	51.7
Total weight ÷ total heating surface, per cent	73.6
Volume both cylinders, cu. ft	13.46
Total heating surface ÷ volume of cylinders	208
Grate area ÷ volume of cylinders	3.78



Side Elevation, New Grand Trunk Locomotives.

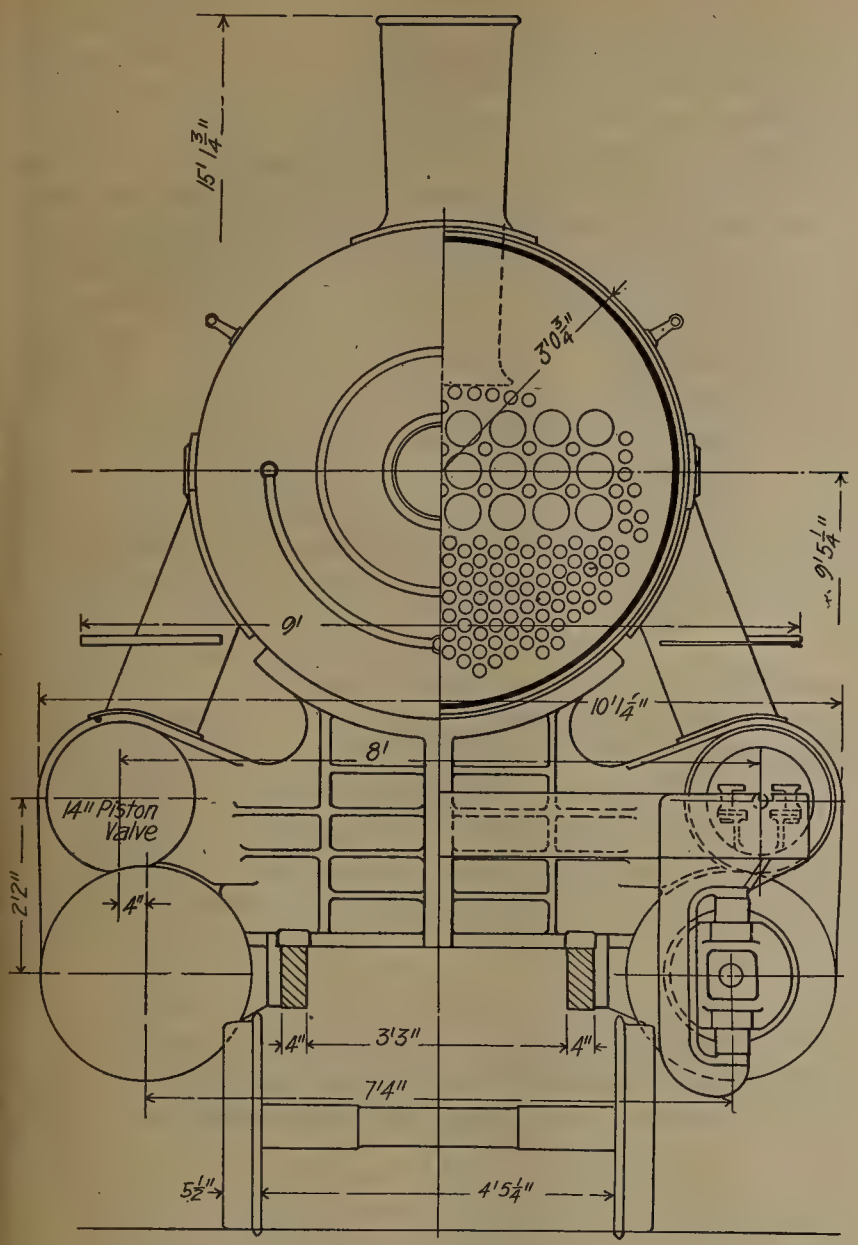
LOCOMOTIVE LUBRICATION IN CONNECTION WITH USE OF SUPERHEAT.*

By Dr. P. H. Conradson.

The roads that have gone into the superheated steam question, in locomotive practice most energetically and on a large practical scale are the Canadian Pacific and Great Northern and one or two more roads. To these roads we are greatly indebted for the practical knowledge and experience gained as to the efficiency, economy and utility of superheated steam in comparison with saturated steam in locomotive service in accordance with existing conditions here, and from which the rest of us will much benefit, especially in connection with our subject under consideration.

There are two types of superheaters, the original or early type known as the "Smoke-Box" type and the so called "Fire-Tube" type. With the former a relative low degree of superheat from 50° Fah., to 100° Fah., is generally produced; —with the latter high degree of superheat from 150° Fah., to 300° Fah., or higher.

* From a paper read before the Western Railway club.



Front End Section, Grand Trunk Locomotives.

There seems to be some confusion in the term "degree of superheat," and before going further into the subject we may as well make ourselves clear on this point. We often hear they have or use very high superheat. It may be so or it may not, unless qualified with a given boiler pressure and steam chest temperature. One hears of 100, 150, 200, 250, and 300 degrees superheat, or 500, 550, 600, and 650 degrees temperature at the steam chest.

Let us for illustration take 300 degrees superheat at 160 pounds boiler pressure. This should mean 664 degrees Fah., temperature at the steam chest, and with the same degree of superheat with 210 pounds boiler pressure, 686 degrees Fah., temperature at the steam chest.

On the other hand, one hears of steam chest temperatures of 550 degrees Fah., or 650 degrees Fah., with a boiler pressure of say 175 pounds corresponding to a steam temperature of 371 degrees Fah., and with 550 degrees Fah. steam chest temperature we have 550 degrees—371 degrees=179 degrees Fah. of superheat. With a steam chest temperature of 650 degrees Fah. we would have, with a boiler pressure 200 pounds per square inch, a superheat of 268 degrees Fah., and with a boiler pressure of 175 pounds 279 degrees Fah. of superheat.

From this you will appreciate that in speaking of degree of superheat it is well to state both boiler pressure and temperature corresponding to same, as well as the temperature of the steam as it leaves the superheat or enters the steam chest.

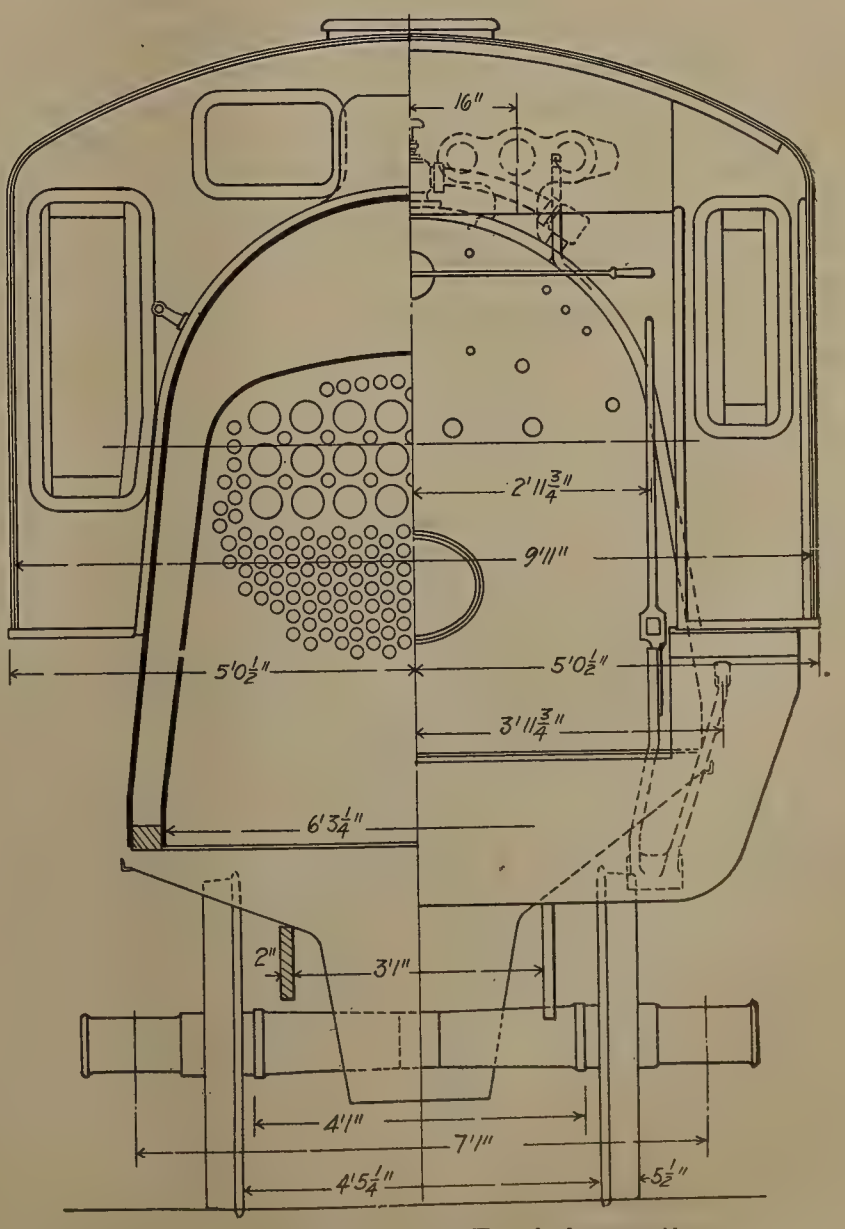
As is well known, saturated (wet) steam possesses a certain amount of lubricating qualities, this owing to the presence of suspended water vapor, or moisture, it might be likened with fog; i. e., minute microscopic globules of water vapor interpersed with the gaseous steam. Superheated steam, at least at high degree of superheat making the steam absolutely dry, free from suspended water vapors, takes the physical properties of or follows the laws of perfect gases very nearly; see "Properties of Steam," by Peabody, and others.

In this superheated or dry state the steam apparently has no inherent lubricating qualities whatsoever, that is, as long as it is in a perfectly dry state or condition. As soon, however, as the temperature and pressure is reduced sufficiently so as to throw out in suspension water vapor or moisture, the steam becoming wet or saturated, it resumes its lubricating properties.

In locomotive superheat practice as advocated at least abroad a high degree of superheat is aimed at, that is, a sufficient excess of superheat, so as to prevent condensation in the cylinders, that is, dry superheated steam goes out in the exhaust. Such practice requires close attention to the problem of valve and cylinder lubrication, which besides a proper oil also very materially and essentially includes proper design of valves and cylinders, bushings and piston rings, as well as the metal used in these parts. I will take this matter up as I go along in a little further detail.

In the early practice in this country in connection with superheated steam trouble from cracked or broken cylinders and other steam parts were often encountered and the trouble oftentimes laid to the valve and cylinder oil. However, by modifying the design and using better or higher grade of metal, these difficulties have almost disappeared, at least on railroads which have had a great deal of experience.

As an illustration of the importance of a suitable material in the piston rings, besides proper design, in connection with high superheated steam, I may state that there is a certain railroad in the Northwest, now having several hundred locomotives equipped with superheaters using rather high degree of superheat (200 to 250 degrees F.). When they first



Section at Firebox, Grand Trunk Locomotives.

started in the superheaters they were using ordinary gray iron metal in their steam chest and cylinder piston rings similar to that they were using in their saturated steam engines, and they had a great deal of trouble from these rings wearing out. This road is now using a dense, fine grained, high-grade air-furnace iron, and are getting, so stated, from 18,000 to 30,000 miles per piston ring, while with the old ring metal they got less than 1,000 miles. In fact, with the new metal this road is now getting as good mileage out of the rins with their superheaters as they were with their saturated steam engines.

Another road with a large number of superheated steam locomotives has had about the same experience. Of course it should be borne in mind that the metal in the piston rings probably varies a great deal in the chemical composition as well as the physical structure of the different roads, therefore the above cannot be laid down as a general rule. Each road adopting superheaters will have to find out the best material to use according to their engine practice, degree of superheat and other conditions. However, from this you will realize the importance of suitable metal in your piston rings in connection with valve and cylinder lubrication of superheated steam locomotives. In the above cited cases the same oil was used with both the old ring material and the new. This is to emphasize the fact that when one considers valve and cylinder lubrication in general, both with saturated and superheated steam, one has to go further than the oil itself.

Some apprehension has in the past prevailed with railroad officials as well as with the locomotive engineers that valve oil would not stand a high degree of superheat, but would burn or carbonize in the steam chests.

I say that a properly compounded, high grade valve oil for superheated steam purposes, will neither burn nor carbonize in superheated steam, even as high superheat as 800 to 1,000 degrees Fah. On the other hand, it is possible to partly carbonize even the best of valve oils in what might be called unfair treatment or unsuitable or improper locomotive practice. Of course if you try to put the same degree of heat upon the oil, or get the same degree of heat in your steam chest and cylinders, and admit air or other gases and exclude the steam, you will certainly carbonize or burn your oil, even the best kind of oil, because it can be burned; it is not asbestos. It is necessary to take certain precautions to prevent the accumulation of carbonized or burned oil or foreign material in your steam chest and cylinders. As I said, it is possible to carbonize even the best valve oil in what might be called unfair treatment or unsuitable or improper locomotive practice.

This statement leads me to say a few words in connection with some other factors that have an all-important bearing on the problem of successful valve and cylinder lubrication of superheated steam locomotives.

It has been found good practice to crack the throttle so as to let into the cylinders a small amount of steam when the engine is drifting, and still better to use a so called drifting valve, i. e., a steam pipe leading from the dome through the cab to the cylinder:—when the throttle is shut off in drifting the drifting valve is opened, letting in a sufficient amount of steam into the cylinders, this prevents either cold air from being drawn in, thus avoiding sudden cooling of the cylinder walls;—or the drawing in of dust, ashes or cinders from the smoke stack gases:—or another device largely used in superheated steam practice, namely the so called by-pass. It consists of a steam passage which connects both cylinder ends, which passage is closed by a cylindrical cock in the middle. So long as the engine is running under steam the cock is kept closed. When the throttle is closed the engineer opens the by-pass valve. This practice prevents either cold air or smoke stack gases with their dust and dirt from being drawn in, thus greatly aiding the lubrication.

The following illustrations are to the point in connection with the drawing in of the smoke stack gases with their dirt, cinders and ashes into the cylinders when the engines are drifting, and what I would call unsuitable or unfair engine practice. I have had occasion to examine deposits accumulated on locomotive cylinders and piston heads from some railroads, where the use of drifting valves have not been adopted in general practice. A few of these accumulations show as follows:

1.

13.35% thick oil.
2.60% oily, gummy matter.
57.15% carbonaceous combustile matter (coal and coke matter).
26.90% red ash, principally iron oxides, silicious matter.

After removing the oil and oily matter, the deposit was non-magnetic, indicating practical freedom from metallic iron.

2.

24.25% thick oil.
0.90% oily, gummy matter.
48.78% iron metal wearings.
8.18% iron oxides and silicious matter.
17.87% carbonaceous combustible matter.

After extracting the oil and oily matter, the deposit was very strongly magnetic containing a large amount of metallic iron.

3.

6.45% oil and oily matter.
35.70% coky, carbonaeous combustible matter.
57.28% metallic iron, iron oxides and silicious matter.

Mineral matter strongly magnetic from metallic iron wearings.

4.

4.2% oil and oily matter.
41.0% metal wearings, iron oxides, silicious matter.
54.0% coky, carbonaceous matter.

Mineral matter strongly magnetic.

The above clearly illustrates the advisibility of preventing smoke-stack gases with their inherent dirt, dust, grit, etc., to be drawn into the cylinders while the engines are drifting. As seen from the analyses a comparatively small amount of oil binds together a large amount of mineral matter forming a sticky deposit which bakes on the metal much harder with superheated steam, especially high superheat, than would be the case with ordinary wet or saturated steam.

Now this means that most of this deposit does not come from the oil. When engineers open up their steam chests and cylinders and find deposits they think that it comes from carbonized oil. Now I do not agree with that, far from it, because if you remove all the carbonaceous matter that comes from the ashes and cinders, and the mineral matter such as iron oxides and silicious matter, you will find very little oily matter, and then we come back to the point of the importance of using a so-called drifting valve during the time the engine is drifting and the live steam is shut off, that is, when the enine is not running on steam. If you have an auxiliary pipe admitting a certain amount of steam into the steam chest and the cylinders, that will prevent the cool air from getting in and chilling the walls of your cylinders, it will prevent ashes and cinders being drawn in. I consider this one of the most important things in locomotive practice in connection with superheated steam as well as saturated steam.

I have found another interesting thing. In alkali or foamy water districts the superheaters aid the valve and cylinder lubrication. I had occasion recently to examine two locomotives equipped with superheaters that had been in continuous service over a year in an alkali water district where the boiler water foams badly. I found the superheater tubes on

the inside practically clean and free from deposit of any kind and not much black deposits in the cylinder and piston heads. The superheaters convert the moisture and water sprayed or carried over with the steam from the priming or foaming water in the boiler, into dry steam, thereby preventing flushing or washing away of the oil from the steam chests and cylinders which oftentimes is the case, besides preventing loss in power of the engine;—or in other words, you will find, when you have had experience with the use of superheaters in bad, foamy water districts, that you will get much better results from superheated than saturated steam, and that the lubrication will go in much easier, besides using less oil.

While some railroads are using "D" valve or flat or slide valves in their superheated steam locomotives, and claim to get satisfactory valve and cylinder lubrication;—the degree of superheat in these engines is generally low;—high degree of superheat requires piston valves for a successful lubrication, besides for other practical reasons, this I believe is now pretty well recognized.

The next points to consider in connection with the problem of valve and cylinder lubrication of superheated steam locomotives are the methods or manner of feeding, and introducing the oil to the parts to be lubricated.

In the early trials and developments of superheated steam locomotive practice on this side of the ocean, valve oil was fed both to the steam chest and cylinders, using hydrostatic lubricators as well as mechanical pumps in both simple and compound engines.

After getting over the "nervous" tension and gaining more experience in the handling of superheaters and superheated steam locomotives, the number of feeds have dropped down to a minimum. Instead of having, as related in some instances, five to seven feeds from the lubricator in the cab, besides mechanical pumps on some roads they now use for simple engines only one feed into each steam chest, or preferably above the same, into the steam pipe or saddle casting, and none into the cylinders from the lubricator in the cab or as used oridinarly in saturated steam practice, and with compound engines only one feed, namely, into the high pressure steam chest, or above into the steam pipe, discarding the feed direct into the high pressure cylinder and low pressure steam chest and cylinder when working steam, claiming to get satisfactory results. However, when drifting it is good practice to feed some oil into the low pressure cylinder through the drifting valve steam pipe.

One of the most important factors outside of the proper quality of the oil in successful lubrication is the condition in which the oil is introduced into the steam chests and cylinders. If we consider the small amount of oil used and the relatively large surface it has to cover or lubricate under the most adverse conditions, the wonder is that so good results have been obtained even with saturated steam. With the era of superheated steam in locomotive service, more attention of necessity has been and will be given to the problem of valve and cylinder lubrication; therefore some years ago the writer began to study the question of how to introduce the oil into the steam and cylinders so as to get the best and most economical results. With this end in view I made some laboratory experiments with a simple atomizer such as used in drug stores for spraying or atomizing perfumes or lotions. Removing the rubber bulb I attached the steam connection, and warming the thick oil a little, it was found very easy to atomize or spray the oil in a highly divided state, like a fine mist mingled with steam, even at an astonishingly low pressure.

This simple atomizer attached to the tallow pipe, such as I used in my first experiments, will show you how easy it is to convert the heavy superheated valve oil into a fine spray or mist.

This method of introducing the valve oil in an emulsified, highly divided or atomized state into the superheated steam gives very satisfactory results whenever tried in practice. I can see no reason why this same method should not be also adopted with saturated steam, both in stationary and locomotive practice.

The next point of interest will be to say something about the requisite qualities a suitable valve oil for superheated steam locomotive service, should posses.

When you start your engine or train, the condition of the steam is exactly the same as ordinary wet or saturated steam,—more or less moisture or condensation in the steam chest and cylinders. This condition continues for some little time, or until the superheater elements get in their good work, the steam gradually getting hotter and hotter and drier and drier until the requisite or desired superheat is reached. This if course depends on the size and speed of the train, road conditions, etc. This condition to a greater or less extent repeats itself every time the train stops at stations or sidings. Than again we have the condition when the engine is drifting for a longer or lesser time, which also upsets the superheated steam efficiency factor with a direct bearing upon the requisite quality of the oil. This whether the drifting valve with its auxiliary steam pipe for admission of small quantities of steam during drifting, or cracking the throttle, or the use of a by-pass, is adopted.

Therefore the requisite qualities that a high grade and suitable valve oil should possess for the intermittent and variable service conditions existing in superheated steam locomotive service might be tersely expressed as follows:

1st. It should be readily emulsified and atomized with the steam.

2nd. It should have the requisite body or viscosity, with sufficient adhesive property to properly lubricate at the highest temperature found in service without carbonizing, and be free from gummy, tarry and asphaltic constituents.

3rd. It should be elastic, so to speak, so as to fulfil its functions, whether the engine is working under saturated or wet steam conditions, or with the highest degree of superheated steam, or during drifting.

Or, in other words, the oil should be automatic in its behavior, so as to adapt itself readily to the above variable conditions; not too volatile, not too sluggish, readily intermingle in a highly divided state with the steam, and spreading itself in this condition over the surfaces to be lubricated.

TRAVELING ENGINEERS CONVENTION AND OTHERS.

The annual convention of the Traveling Engineers' Association, for 1912, will be held at the Hotel Sherman, Chicago, on August 27, 28, 29 and 30. Last year's convention, which was held at the same place was so successful that it was decided to hold it there again this year. Chicago, which is undoubtedly the largest railway center in the world, is probably the most accessible and desirable city in the country for holding railway conventions. Within the past year or two the hotel facilities have been greatly increased and all recent conventions have been marked with success both from the standpoint of attendance and enjoyment. The popularity of Chicago as a convention city is shown by the following list of railway conventions which are to be held there during the coming summer and fall. Most of the conventions are of interest to railway mechanical men.

American Association of Freight Traffic Officers, Chicago, November 15, 16, 1912.

American Electric Railway Association, Dexter Pavilion, Chicago, October 7, 8, 9, 10, 11, 1912.

American Railway Tool Room Foremen's Association, Hotel Sherman, Chicago, July 9, 10, 11, 1912.

Association of Railway Electrical Engineers, La Salle Hotel, Chicago, October, 21, 22, 23, 24, 25, 1912.

Central & Western Association of Car Service Officers, Chicago, October 17, 1912.

Chief Interchange Car Inspectors' and Car Foremen's Association, Palmer House, Chicago, August 27, 28, 29, 1912.

International Railroad Master Blacksmiths' Association, Hotel Sherman, Chicago, August 20, 21, 22, 23, 24, 1912.

International Railway Fuel Association, Hotel Sherman, Chicago, May 22, 23, 24, 25, 1912.

International Railway General Foremen's Association, Hotel Sherman, Chicago, July 23, 24, 25, 26, 1912.

Maintenance of Way Master Painters' Association, Chicago, November, 19, 20, 21, 1912.

Traveling Engineers' Association, Hotel Sherman, Chicago, August 27, 28, 29, 30, 1912.

AN OPEN LETTER.

To the Onorable Ass. of Intersthate Body of Commuce Esquire.

Dear Surs: I wud herebye rispictfuly pittition yez to imajitly ordur ivory box kar off the hracks til the same is equiped wid a dacint draft sphring.

Tis in the cause of humanity I write this. In these days whin so manny of our able fello citizens make free use of these vehicles for transpoortation it is imperitiv that they be made as comfurtable as possibul.

At prissint wid the old fashioned draft sphring it is impossible for the poor warefarin man to injoy continus slape the trip thru.

An yez can prove it for yeresilves wid wan (1) nights exparience, drunk or sober in any kar yez may pick yez will find that any quick stop will wake yez from the swatist of drames but, that is nothing to what is coming to you when they switch the kar agin a solid cut of kars. 'Tis then the unit of resyllyance of the ould fashioned sphrings will fale to work and yere hed will strike agin the end of the kar causing a combination of defects chargibel to the deliverin road.

At prisint there is no M. C. B. rool wherebye ye can recover for the damage ye sustain and ye are d—md lucky if yez recover *from* the damages ye hav already recaived. I'll, lave it to yereselves after enjoying wan (1) night of broken rest, (laving alon the broken hed) ye'll laave the kar in the marnin that dazed ye'll be reddy to kommit any krime mentshuned in the newspapers an ye'll agree wid me that the d—d jerky kars are responsible for most of the krimes kommitted by the thramps.

If ye were put on a jury of their piers to thry them for their misdemanurs ye would acquit them unanimously—And who *is* to blame? The car owners to be sure an thats the rason, gentlemin, that I am appaling to yez to put an imajate stop to this impossition on the thramp.

Hevin speed the day, whin every night the poor man can slape the week thru on his journeys in a fine aisey riding box car.

I have prepared a new Rule of Intirchange which I ask yez to introduce at the June convintion of the M. C. B.s not at prisint being a member therof miself. Tis this:—

"Owners Responsibul

Any box car found after September 1st, 1912 not equipped wid assey working draft Sphrings, able to absorb all blows, impact, resylliency and recoil must not be offered in interchange until so equiped as afoursed.

Aither that or all such kars shall have the linning at the too (2) inds heavily padded so that no substance shall be injured by coming in violent contact wid the same.

If yez illict to put in the paddin this fact shall be stencilled on the kar prefiribly in eluminated paint so it kan be red at nite widout specks.

The expinse there off shall be chargeable to the kar owner, if any."

Now then gintliman I am kounting on ye to ably second me in my humane effurts. If yez should fail me remember that the Recall will be in force next year and then to H—l ye'll go.

Respt.

TIM.

RAILWAY MOTIVE POWER STATISTICS.

The Bureau of Railway Economics has compiled from reports of the Interstate Commerce Commission a large number of tables of statistics relative to railway traffic in the United States. We give in the tables herewith such of these statistics as relate to motive power and equipment. The Roman figures I, II, III, etc., at the top of each column refer to the territorial group into which the country has been divided by the Interstate Commerce Commission and generally speaking run from the Atlantic toward the Pacific coast. The section of country included in each group may be seen by reference to the map. These figures are for the years 1900 to 1910 inclusive, covering the period of depression and are of interest to those who are watching the trend of railway problems.

Figures for locomotive tractive power are lacking for 1900 and 1901, but taking the figures for 1902 to 1910 inclusive it will be seen that the aggregate increase in tractive power of locomotives is over 820 million pounds, or an increase in eight years of 107 per cent. During this same eight years the average tractive power per locomo-

LOCOMOTIVES PER 1,000 MILES OF LINE

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	195	330	449	246	147	130	165	118	133	110	124
1901	202	333	471	253	158	137	166	123	142	111	134
1902	206	338	482	257	162	137	172	123	153	114	129
1903	214	348	487	273	171	140	181	129	162	118	132
1904	220	359	501	286	183	149	189	140	166	116	128
1905	223	374	507	294	189	154	189	133	167	118	133
1906	232	372	547	310	201	161	193	147	171	122	135
1907	243	385	562	325	223	172	200	170	173	124	165
1908	246	409	563	332	232	173	202	169	176	129	172
1909	243	406	561	332	224	170	202	170	174	134	163
1910	245	406	571	344	222	168	207	178	176	132	161

	TRACTIVE POWER OF LOCOMOTIVES United States (pounds) Aggregate	Av. per loco.	CAPACITY OF FREIGHT CARS United States (tons) Aggregate	Av. per car
1900	--- --- ---	-- ---	-- --- ---	--
1901	--- --- ---	-- ---	-- --- ---	--
1902	768,502,779	20,485	42,292,977	28
1903	941,915,540	21,781	48,530,281	29
1904	1,052,307,261	22,804	50,759,133	30
1905	1,128,771,082	23,666	53,255,083	31
1906	1,260,633,673	24,741	59,059,302	32
1907	1,409,006,658	25,823	67,033,324	34
1908	1,477,756,536	26,384	72,663,665	35
1909	1,503,971,444	26,634	73,137,546	35
1910	1,588,894,480	27,282	76,578,735	36

PASSENGER CARS PER 1,000 MILES OF LINE

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	180	549	474	188	113	121	130	80	93	79	129
1901	184	550	496	192	120	119	130	86	97	81	130
1902	185	558	498	189	122	120	132	88	105	82	127
1903	186	563	488	194	125	118	138	88	107	82	130
1904	187	582	494	197	126	119	140	99	108	83	131
1905	188	587	493	201	132	120	140	98	108	83	133
1906	190	597	499	201	139	121	139	110	112	84	138
1907	193	610	507	209	150	123	142	114	108	81	153
1908	196	652	521	212	150	120	144	115	109	83	156
1909	193	661	516	212	146	120	144	118	108	82	150
1910	195	660	516	214	150	122	147	121	114	82	163

NUMBER OF LOCOMOTIVES

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	37,663	2,583	9,743	5,890	1,675	2,786	7,351	1,305	3,172	1,312	1,846
1901	39,584	2,632	10,306	6,072	1,830	3,009	7,510	1,391	3,418	1,359	2,067
1902	41,225	2,675	10,621	6,236	1,924	3,105	7,848	1,395	3,898	1,473	2,050
1903	43,871	2,785	11,081	6,644	2,050	3,259	8,401	1,465	4,387	1,620	2,179
1904	46,743	2,892	11,523	7,132	2,236	3,556	9,020	1,612	4,939	1,654	2,179
1905	48,357	3,028	11,806	7,413	2,374	3,788	9,206	1,539	5,086	1,759	2,358
1906	51,672	3,026	12,963	7,964	2,563	4,105	9,667	1,689	5,343	1,893	2,459
1907	55,388	3,142	13,422	8,465	2,906	4,494	10,247	2,028	5,477	2,048	3,159
1908	56,733	3,265	13,338	8,653	3,074	4,653	10,363	2,070	5,677	2,203	3,437
1909	57,212	3,252	13,408	8,651	3,099	4,673	10,402	2,111	5,792	2,365	3,459
1910	58,947	3,297	13,607	8,994	3,102	4,700	10,707	2,480	5,971	2,427	3,662

NUMBER OF PASSENGER CARS

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	34,713	4,293	10,298	4,513	1,287	2,595	5,775	888	2,206	938	1,920
1901	35,969	4,346	10,863	4,598	1,395	2,623	5,845	959	2,343	999	1,998
1902	36,987	4,411	10,990	4,592	1,446	2,733	6,046	995	2,694	1,064	2,016
1903	38,140	4,511	11,115	4,716	1,512	2,743	6,386	1,001	2,892	1,127	2,137
1904	39,752	4,691	11,369	4,900	1,536	2,834	6,663	1,137	3,205	1,185	2,232
1905	40,713	4,752	11,466	5,069	1,654	2,941	6,808	1,135	3,294	1,234	2,360
1906	42,262	4,853	11,823	5,177	1,776	3,085	6,974	1,266	3,498	1,303	2,507
1907	43,973	4,979	12,107	5,434	1,956	3,208	7,242	1,364	3,419	1,337	2,927
1908	45,117	5,204	12,355	5,537	1,990	3,229	7,357	1,412	3,507	1,411	3,115
1909	45,584	5,290	12,336	5,515	2,011	3,304	7,443	1,463	3,586	1,452	3,184
1910	47,095	5,356	12,281	5,593	2,097	3,403	7,611	1,688	3,874	1,506	3,686

tive has increased 33 per cent or one-third. During this period the aggregate capacity of freight cars has increased 81 per cent, while the average increase in capacity per car has been 28.6 per cent. In the same figure it will be seen that the locomotives per thousand miles of line for the entire country was 195 in 1900, and 245 in 1910, an increase of 25.6 per cent in ten years. In the distribution of this increase group IV and VII show the largest gain, each having 51 per cent increase. Passenger cars per thousand miles of line have shown an average increase of 8.3 per cent, in which districts IV and VII also lead with increases of 32.8 per cent and 51.3 per cent respectively. VII it will be noted is the central north-west and IV the southern states on the Atlantic coast line.

The number of locomotives in the United States in 1910 was 58,947, an increase of 56.6 per cent in ten years. The total number of passenger cars at this time was 47,095 and of freight cars 2,135,121, showing increases of 35.7 per cent

TOTAL NUMBER OF CARS (including company's service cars)

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	1,450,838	54,936	414,305	281,214	62,041	96,240	306,059	44,120	108,628	36,725	46,570
1901	1,550,833	56,015	444,653	300,146	68,668	103,281	321,408	45,281	119,104	40,711	51,566
1902	1,640,185	56,507	461,986	312,259	73,379	108,987	336,164	46,486	140,872	46,843	56,702
1903	1,753,389	58,669	472,793	332,800	79,683	120,903	367,424	45,638	159,799	53,650	62,030
1904	1,798,561	62,571	470,091	337,997	82,643	127,929	376,752	54,368	170,902	53,618	61,690
1905	1,842,871	63,002	467,872	349,266	87,554	138,637	386,932	57,119	173,914	53,762	64,873
1906	1,958,912	66,756	494,117	372,151	97,554	153,812	405,582	61,453	184,814	55,597	67,076
1907	2,126,594	72,739	528,683	401,728	117,998	175,232	431,538	66,148	188,619	57,879	86,030
1908	2,231,181	86,168	545,756	416,949	125,522	181,588	446,106	67,643	207,501	63,016	90,932
1909	2,218,280	91,198	534,847	406,127	126,097	182,710	447,407	70,568	200,790	65,418	93,118
1910	2,290,331	92,580	547,383	422,881	130,815	183,019	454,875	83,390	207,483	66,333	101,572

FREIGHT CARS PER 1,000 MILES OF LINE

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	7,092	6,116	17,990	11,280	5,152	4,182	6,547	3,682	4,244	2,819	2,781
1901	7,488	6,186	19,271	12,037	5,595	4,401	6,803	3,755	4,589	3,021	2,999
1902	7,725	6,232	19,883	12,372	5,838	4,500	7,019	3,763	5,073	3,317	3,189
1903	8,055	6,400	19,704	13,195	6,314	4,878	7,571	3,646	5,449	3,604	3,350
1904	7,973	6,815	19,333	13,002	6,412	5,029	7,530	4,360	5,299	3,432	3,197
1905	7,980	6,817	18,976	13,263	6,586	5,280	7,552	4,579	5,273	3,313	3,243
1906	8,266	7,224	19,660	13,821	7,240	5,642	7,675	4,939	5,476	3,283	3,228
1907	8,756	7,861	20,879	14,721	8,610	6,301	7,993	5,033	5,462	3,196	3,932
1908	9,064	9,703	21,742	15,252	8,979	6,329	8,236	4,961	5,933	3,367	3,973
1909	8,809	10,268	21,128	14,863	8,653	6,212	8,183	5,095	5,527	3,363	3,802
1910	8,866	10,233	21,679	15,396	8,867	6,105	8,264	5,322	5,564	3,266	3,820

NUMBER OF FREIGHT CARS

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	1,365,531	47,779	390,694	270,553	58,518	89,887	291,220	40,762	101,043	33,562	41,513
1901	1,464,328	48,841	421,646	288,875	64,892	96,931	307,058	42,071	110,650	37,102	46,262
1902	1,546,101	49,298	438,415	300,384	69,355	102,188	321,130	42,525	129,469	42,783	50,554
1903	1,653,782	51,265	448,464	320,249	75,571	113,603	350,996	41,572	147,444	49,375	55,243
1904	1,692,194	54,931	445,056	324,536	78,164	119,950	358,412	50,231	157,288	49,149	54,477
1905	1,731,409	55,152	441,761	334,402	82,588	129,680	367,545	52,893	160,606	49,260	57,522
1906	1,837,914	58,734	465,545	355,193	92,385	143,763	384,517	56,895	171,403	50,751	58,728
1907	1,991,557	64,142	498,791	382,908	112,102	164,148	408,337	60,144	173,142	52,578	75,265
1908	2,089,302	77,430	515,271	397,615	118,786	169,862	421,913	60,718	191,047	57,405	79,255
1909	2,073,606	82,140	504,742	387,039	119,333	170,760	422,240	63,278	183,938	59,566	80,570
1910	2,135,121	83,091	516,299	402,915	123,831	170,786	428,353	74,166	189,138	60,015	86,527

TON MILES PER FREIGHT LOCOMOTIVE

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	6,556,731	4,234,103	7,411,662	8,955,447	7,322,002	6,394,979	5,955,862	4,340,818	4,901,183	5,538,281	4,849,114
1901	6,439,735	4,319,824	7,091,771	8,689,756	6,907,780	6,283,433	5,928,529	4,495,307	4,934,502	6,236,786	5,028,720
1902	6,666,499	4,512,190	7,101,980	9,087,499	6,914,479	6,623,442	6,377,796	5,153,827	4,944,201	5,756,776	5,599,381
1903	6,807,242	4,662,361	7,429,808	9,125,380	6,350,626	7,567,427	6,358,395	6,322,675	4,441,038	5,539,955	6,453,356
1904	6,456,646	4,545,802	7,256,025	8,246,802	6,200,204	6,818,771	5,899,909	6,052,703	4,210,594	5,544,225	6,774,946
1905	6,690,700	4,520,979	7,481,237	8,855,139	6,651,603	6,894,746	6,168,544	7,521,808	4,217,603	5,007,790	6,227,096
1906	7,232,563	4,882,999	7,700,669	9,532,204	7,126,887	7,381,481	6,830,977	8,551,921	4,742,878	5,526,383	7,103,471
1907	7,375,585	4,962,780	8,118,634	9,711,637	6,669,760	7,312,871	7,165,519	6,987,404	5,321,440	6,047,000	6,059,478
1908	6,488,829	4,478,833	7,593,575	8,127,018	5,894,259	6,281,108	6,262,040	6,180,675	4,684,525	4,884,350	5,322,360
1909	6,447,708	4,568,910	7,215,745	8,141,015	6,359,273	6,466,306	6,332,602	6,492,472	4,702,412	4,618,145	5,206,597
1910	7,304,065	4,798,446	8,070,619	9,616,080	7,872,066	7,588,386	7,076,838	6,862,294	5,103,078	4,780,554	5,971,937

PASSENGER MILES PER PASSENGER LOCOMOTIVE

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	1,626,179	1,875,656	1,554,869	1,570,469	1,472,554	1,293,732	1,671,308	2,098,355	1,257,737	1,479,021	2,781,025
1901	1,704,005	1,820,455	1,576,825	1,615,908	1,565,711	1,346,075	1,802,969	1,988,174	1,636,983	1,750,389	2,866,651
1902	1,908,310	1,930,279	1,796,662	1,991,093	1,663,712	1,412,981	1,980,814	2,334,597	1,620,367	1,969,564	3,493,645
1903	1,978,786	2,008,497	1,888,089	1,960,359	1,676,986	1,739,479	2,045,047	2,518,422	1,586,166	1,809,130	3,374,740
1904	1,948,384	1,877,812	1,874,006	1,957,454	1,792,476	1,807,420	1,957,765	2,383,335	1,524,540	1,797,088	3,509,145
1905	2,048,558	1,921,548	1,950,165	1,939,205	1,888,660	2,096,120	2,134,369	2,630,404	1,769,143	1,861,099	3,214,327
1906	2,054,636	2,063,930	1,989,716	1,912,263	1,914,563	1,914,733	2,014,216	2,407,217	1,742,027	1,949,846	3,552,528
1907	2,163,146	2,162,517	2,164,724	2,047,952	1,809,628	2,033,737	2,158,723	2,836,385	1,700,212	2,628,347	3,005,162
1908	2,205,752	2,131,864	2,164,678	2,091,732	2,023,196	2,015,183	2,282,213	3,030,013	1,861,129	2,313,437	2,916,576
1909	2,185,877	2,167,627	2,099,771	2,080,436	1,854,339	1,946,599	2,304,645	3,007,122	1,922,399	2,339,334	2,855,318
1910	2,354,748	2,304,679	2,278,929	2,206,925	1,952,651	2,178,294	2,567,200	2,770,661	2,005,975	2,438,378	3,082,416

and 56.4 per cent respectively. The largest gain in locomotives was made by district X (the Pacific coast), the increase being 98.3 per cent, almost double, with districts VII, VIII, IX and IV closely following. Districts X and IV lead in increase of freight cars with 110 per cent (more than double) and with V and VIII closely following. In increase in passenger cars district VII leads, with 90 per cent, VIII coming next with 75.7 per cent and IV having 62.8 per cent. In the total number of cars of all kinds there has been an increase in the United States in the 1900-1910 period of 58 per cent.

It will be seen that the districts which have shown the greatest proportional increase in equipment are X, VII, IV, VIII and V, that is, the territory west of the Missouri and Mississippi, excepting Texas, and the southern states east of the Mississippi. Of these two sections, the increase of rolling stock in the southern states, particularly along the Atlantic coast, is the more surprising and gratifying as well, for the southern states are now making great strides. The lagging of the increase in the Texas district behind that of the surrounding territory may be attributed to the stringent laws in effect there.

Ton miles per freight locomotive reached a maximum in 1906 and 1907, at which time there was a marked falling off. However, the aggregate for the entire country in 1910 had again nearly reached the maximum. In ton miles per freight locomotive, the Pacific coast again leads the increase in 1910 over 1900, being 23 per cent. The Texas district shows a decrease for the same years. The southern states follow the Pacific coast, with substantial increases.

PROPOSED CHANGES IN THE RULES OF INTERCHANGE.*

The committee appointed to suggest changes in the M. C, B.-Rules of Interchange begs leave to report as follows:

Preface. Change Third paragraph to read as follows, "Inspection of freight cars for interchange and method of loading will be in accordance with this code of rules, the requirements for tank cars and the rules for loading materials, issued by this Association.

Rule 1. Change to read as follows, "Each railway company shall give to foreign cars, while on its line, the same care as to oiling, packing, inspection and adjusting brakes,

*Report of committee as accepted by the Western Railway Club, April 16, 1912.

FREIGHT TRAIN MILES PER FREIGHT LOCOMOTIVE

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	22,808	22,805	20,304	26,517	22,882	28,187	22,880	18,573	24,235	25,755	16,135
1901	21,540	20,496	18,995	24,981	20,537	28,056	21,813	18,250	21,490	27,155	15,488
1902	21,180	21,121	18,196	24,553	19,952	27,515	21,657	17,641	21,234	25,315	16,399
1903	20,685	21,436	17,647	23,271	18,934	30,961	20,920	20,727	17,978	23,482	18,032
1904	19,797	21,428	17,439	21,776	17,724	28,701	19,678	18,403	17,050	22,710	18,868
1905	19,607	20,221	17,672	22,119	17,866	28,687	18,898	18,701	17,129	20,978	17,597
1906	19,901	21,053	17,434	21,883	18,061	29,005	19,402	20,682	17,922	20,985	18,735
1907	19,639	20,428	17,441	21,336	17,159	28,263	19,566	17,290	18,771	23,223	16,134
1908	17,448	18,292	15,962	19,032	15,351	24,413	17,173	15,019	16,885	19,737	13,789
1909	16,763	17,600	14,687	18,547	15,282	23,195	17,126	15,501	16,752	17,381	12,472
1910	18,160	18,253	15,381	20,578	17,040	24,999	18,485	17,282	17,902	18,055	14,341

PASSENGER TRAIN MILES PER PASSENGER LOCOMOTIVE

	U.S.	I	II	III	IV	V	VI	VII	VIII	IX	X
1900	36,852	30,511	31,996	38,907	41,211	38,931	43,716	47,411	35,314	40,217	39,653
1901	37,821	29,527	31,281	39,025	42,533	38,674	46,843	45,862	43,117	41,541	43,325
1902	39,311	30,577	32,988	43,723	42,996	39,228	47,018	46,412	39,138	43,648	49,332
1903	40,222	31,111	33,881	43,170	44,441	47,118	46,547	49,070	39,276	44,158	46,740
1904	39,145	29,492	33,530	42,708	47,105	47,250	44,012	43,679	36,895	42,226	47,563
1905	39,579	29,013	34,412	42,274	48,394	50,552	43,789	44,092	38,884	41,026	44,065
1906	39,108	29,729	33,513	42,434	46,487	48,324	43,595	37,891	38,426	40,766	45,926
1907	39,748	30,310	35,195	43,008	42,085	48,806	44,682	43,039	37,028	48,503	39,514
1908	38,373	29,285	34,372	41,490	40,515	46,631	42,539	44,062	36,248	43,050	37,876
1909	37,997	28,736	34,163	41,253	39,653	44,972	41,824	43,765	34,837	42,836	39,928
1910	40,191	29,742	35,451	42,457	43,470	49,037	44,800	43,514	37,112	45,226	44,114

including tightening of unions and adjusting angle cocks, that it gives to its own cars, without charge."

Rule 2. Change Fifth paragraph to read as follows, "Loaded cars offered in interchange must be accepted, except that receiving line may reject cars not loaded in accordance with the rules for loading materials, A. R. A. Car Service Rule No. 15 to apply (see page 88) when transfer or rearrangement of load is necessary. The delivering line will not be charged with cost of transfer if repairs can be made within 24 labor hours as shown in M. C. B. Rule No. 107."

Rule 12. Make first paragraph read, "The evidence of a joint inspector, or the joint evidence of two inspectors, one in the employ of the owner of the car and the other representing a railroad company, that the repairs are not proper shall be final: The evidence to be signed only after an actual inspection has been made."

Add a paragraph as follows, "If repairs are not corrected at time of the inspection, the joint evidence card shall be attached to car as per Rule No. 14."

Rule 13. Change to read as follows, "The joint evidence card, showing information contained on a proper repair card, upon which a bill has been made, shall be used as authority for rendering bill. If no bill is rendered, the joint evidence card shall be so marked and sent to the company against whom the evidence has been presented, and it shall furnish a defect card covering the wrong repairs, if it made them."

Rule 14. Change third paragraph to read, "Defect, repair and joint evidence cards must be securely attached to the car with four tacks," balance of rule to remain as at present.

Rule 24. Change second paragraph to read, "In no case should two wheels be mounted on same axle when the thickness of the two flanges together will exceed the thickness of one normal and one maximum flange, or 2 17-32 inches."

Rule 33. Change to read as follows, "Side and end doors missing from bodies of cars offered in interchange."

Rule 34. Omit.

Rule 35. Add a paragraph reading as follows, "After Sept. 1st, 1914, cars equipped with stem or spindle attachment couplers will not be accepted in interchange."

Rule 36. Omit entirely.

Rules 37 to 42 inclusive. Your committee wishes to place itself on record as being strongly opposed to the note following Arbitration Case No. 851 and to any changes in the present heading of the above mentioned rules.

We believe that the combinations mentioned should be strictly confined to one end of the car only.

We also strongly urge that second foot note following Rule 42 be changed to read, "It will be assumed that a missing coupler and attachments are not damaged."

Rule 52. Add "Lag screws must not be used to secure safety appliances."

Rule 53. Change rule to read as follows, "All freight cars offered in interchange must be equipped with air brakes, M. C. B. Standard 1¼ inch train line angle cocks, quick action triple valves and pressure retaining valves."

Rule 56. Omit.

Rule 59. Omit reference to Rule No. 56 in last line.

Rule 64. Change to read as follows, "Material missing from trucks of cars offered for interchange, except journal box lids, nuts, brake beam safety chains, brake beam guide pins, brake shoes and brake shoe keys, truck springs, distance pieces and bolts."

Fig. 1.—Principal Parts of Boiler After Explosion.

Rule 98. Show a price for cast steel wheels and steel tired wheels.

Rule 108. Omit "Brake shoes or brake shoe keys," to comply with change in Rule 64.

Rule 116. Attention is called to prices allowed for sub steel underframes, which seems to be too low to be equitable to car owner.

Respectfully, submitted,

H. H. Harvey, Chairman, W. B. Hall, C. H. Osborn, Geo. Thompson, J. M. Barrowdale.

DISASTROUS LOCOMOTIVE BOILER EXPLOSION.

What was probably the most disasterous locomotive boiler explosion in the history of railroading occurred at San Antonio, Tex., March 18, 1912. The boiler of locomotive 704, a Southern Pacific passenger engine of the ten-wheel type exploded with terrific force in the San Antonio terminal yards. The explosion resulted in the death of twenty-eight persons who were, for the most part, shop workers. The blacksmith shop and roundhouse near which the engine was standing were partially demolished. It is probable that the loss reached $200,000.

The explosion may have been caused by overpressure. It

Fig. 2.—Wreck of Boiler and Engine After Debris Had Been Partly Cleared Away.

was stated by witnesses before the Interstate Commerce Commission investigation that the safety valve had been screwed down just previously to the explosion, and that the oil burners had been extinguished and then relighted before the accident.

The locomotive had been in the engine house for overhauling for several weeks, and two days prior to the explosion had undergone the annual hydrostatic test, when the boiler was found to be in good condition. Boilers of this type have a working pressure of 200 lbs. The locomotive was fired up to take out a passenger train and a few minutes before the explosion the engineer had taken charge of it to run it to the passenger station for its train.

The hostler who brought the engine out of the engine house testified that he had filled the tank with water, and the oil tanks were also filled, as it was an oil-burning locomotive. When he turned the engine over to the engineer the steam gage registered 190 lbs., and the injectors were working. The engineer tested the gage cocks, looked at the steam gage, and then took his oil can and got down to oil around the engine. The hostler left the locomotive and walked to the engine house, and was hardly inside the building when the explosion occurred. In addition to the statements of the hostler other evidence includes that of the master mechanic, who was on the engine only 15 or 20 minutes before the explosion, at which time the steam gage indicated 145 lbs. He had gone to his office and was detained there a few minutes to sign some requisitions when the explosion occurred.

The photographic reproductions are published by courtesy of Power.

The wrecked boiler and roundhouse are shown in Figure 1. The only parts of the boiler remaining are the extension front end and the tubes many of which are still fixed in the front blue sheet.

Figure 2 shows the position of boiler with respect to the engine driver, frames, and cylinders after the debris had been partially cleared away. The left back side rod is shown bent into a U shape but still attached to the crank pin.

Figure 3 shows a close view of the boiler and the torn sheets are plainly visible. The roundhouse and remainder of the engine are shown in the background. It will be noted from this picture that the sheets are torn near but not at the riveted points.

Figure 4 shows a view of the frame from the right side. The rear axle 9½ inches in diameter was broken squarely in the middle. The back driver is shown to have been blown off the axle and the tire partially off the wheel. The stars on the ends of the axles which indicate that patent grease cellars are used on these bearings, were being painted at the time of the explosion.

Figure 5 shows the bent main frames, and the bent and broken piston. The bending of the frames at this point was no doubt due to the tearing away of the boiler from the cylinder saddle casting.

Figure 6 is a close view of the front end and the appearance of the remains of the cylinder casting gives an idea of the force of the explosion.

WATER TREATMENT AND BOILER TROUBLES.*

By W. A. Pownall, Water Engr., C. B. & Q. R. R.

When water falls to the earth as rain or snow some of it runs over the surface of the ground into the lakes and streams, and some of it passes into the ground and reappears in springs, wells or in lakes and streams into which it has entered from below. In either case the water dissolves from the surface or from the rocks and earth through which it seeps, a certain amount of mineral matter, and when pumped it contains two classes of mineral salts, the amounts of which determine its degree of fitness for use in locomotive boilers. These are the incrusting salts and the alkali salts; the sum of the two would represent the total solids

*From a paper read before the Western Railway Club, April 16, 1912.

Fig. 3.—Showing Torn Boiler Plate and Bent Tubes.

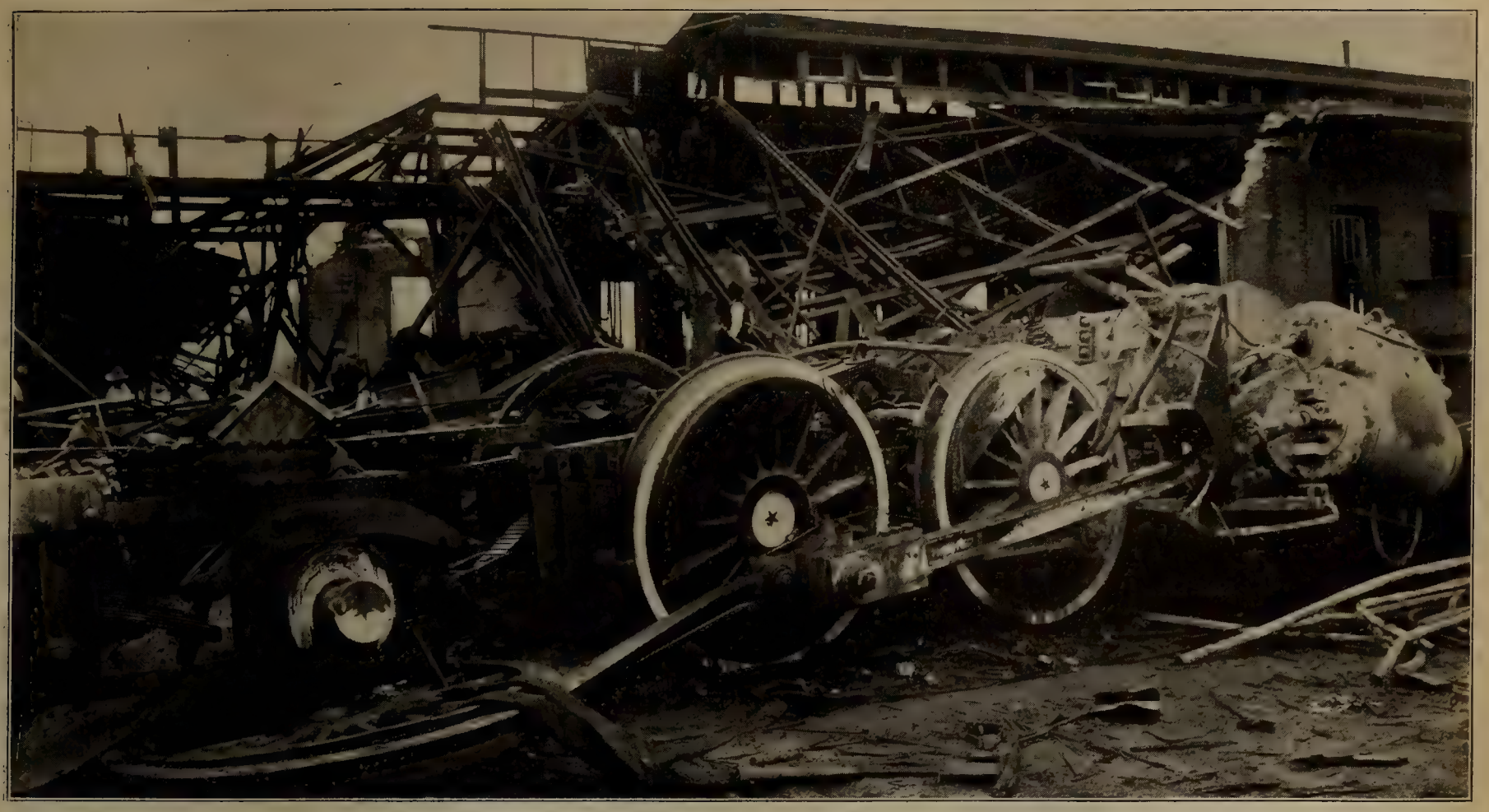


Fig. 4.—Right Hand Side of Frame, Showing Rear Driver Off Axle and Tire Partly Off Wheel.

dissolved in the water and would be the residue left on evaporation.

Total Dissolved Solids	Incrusting Salts or Total Hardness	Carbonate of Lime and Magnesia (Carbonate Hardness)
		Sulphate of Lime and Magnesia. (Sulphate Hardness)
	Alkali Salts	Sodium Sulphate
		Sodium Chloride
		Sodium Carbonate

Incrusting Salts.

The incrusting salts or total hardness may be divided into the carbonate hardness or carbonates of lime and magnesia and the sulphate hardness or sulphates of lime and magnesia. These are perhaps more commonly known as the "temporary" and the "permanent" hardnesses. When water is boiled at atmospheric pressure the carbonate hardness is precipitated either as a soft mud or a bulky scale on the flues and staybolts, according to the condition of the water in the boiler. The sulphate hardness remains in solution when water is boiled at pressure below 60 lbs., but above this pressure it separates out and forms a hard scale on flues and firebox sheets, the result of which is continual trouble from leaky flues, staybolts and fireboxes due to overheating of the metal.

Alkali Salts.

The difference between the total dissolved solids and the total hardness would represent the "alkali" salts or the sulphates, chlorides and carbonates of sodium. These salts remain in solution after the water has been boiled, and when the total amount in the boiler reaches a certain concentration the boiler begins to foam. Waters high in alkali salts are, on account of their tendency to cause foaming, undesirable for boiler purposes.

In addition to these mineral salts surface waters, especially the streams, at times carry large amounts of suspended matter (mud), and this may cause trouble, if the water in the boiler is in a scale forming condition, by baking on the flues or building in to form a heavier scale. The foaming tendency of the water is also aggravated by this mud and by any decayed animal and vegetable matter that may be found in some waters.

The amount and proportions of these mineral salts found in waters vary considerably in different parts of the country. In the territory covered by the C. B. & Q. R. R. the waters are found as follows:

In Illinois the surface waters all contain more or less sulphate hardness and are low in alkali salts. In Iowa and Missouri the surface waters are lower in sulphate hardness and about the same in alkali as the Illinois waters. Shallow wells in these states furnish, with few exceptions, much harder water than the surface supplies. Some wells of moderate depth in sandstone furnish waters containing free

Fig. 6.—Front End View, Showing Broken Saddle Casting and Tilt Due to Bent Frame.

sodium carbonate (soda ash), if they are comparatively near the outcrop of the sandstone, and waters of this type, if not too high in alkali, are desirable as they are non-incrusting. West of the Missouri River in Nebraska well waters as a rule are either low in sulphate hardness or contain free sodium carbonate; these waters, however, increase in the amount of alkali salts as we go westward and have therefore a greater foaming tendency. In Wyoming and South Dakota there are some fairly good quality surface waters, but generally speaking the waters surface and well, are high in both sulphate hardness and alkali salts and it is a case of take what you can get. Some wells in these states furnish waters high in sodium carbonate but with hardly any incrusting water, and while these are foaming waters they are preferable to the waters that are incrusting as well as foaming.

Causes of Boiler Trouble.

The primary cause of leaky flues, fireboxes and staybolts is unequal expansion and contraction brought about by overheating of the metal due to it being insulated from the water by a layer of scale formed by the precipitation of the lime and magnesia salts in the water. These troubles will be accentuated by any sudden cooling of the metal such as heit, while a full glass of water is being fed and the engine is standing still; with the ordinary boiler check this difference will run from 80 to 100 degrees.

There are also a number of different kinds of hot water washing plants that supply hot water blown out from boilers for washing out and hot fresh water for filling boilers. An inexpensive plant consists of a sump into which the water and steam from engines to be washed are blown, enough fresh water being let into the sump to provide the necessary total for washing and filling. There should be some kind of a hot water washout plant at all places where any number of engines are washed, and all engines ought to have some device for heating the water before or as it enters the boiler.

These precautions will avoid sudden cooling, but the important thing is to avoid overheating. If there is no insulating layer of scale on the metal it will never get much more than fifty degrees hotter than the temperature of the water in the boiler, so that even with the cooling effects present, the total temperature variation will not be large enough to cause much trouble. As water in the boiler at 200 lbs. pressure will be at 387 degrees Fahrenheit, the maximum temperature of clean flue ends would be perhaps 440

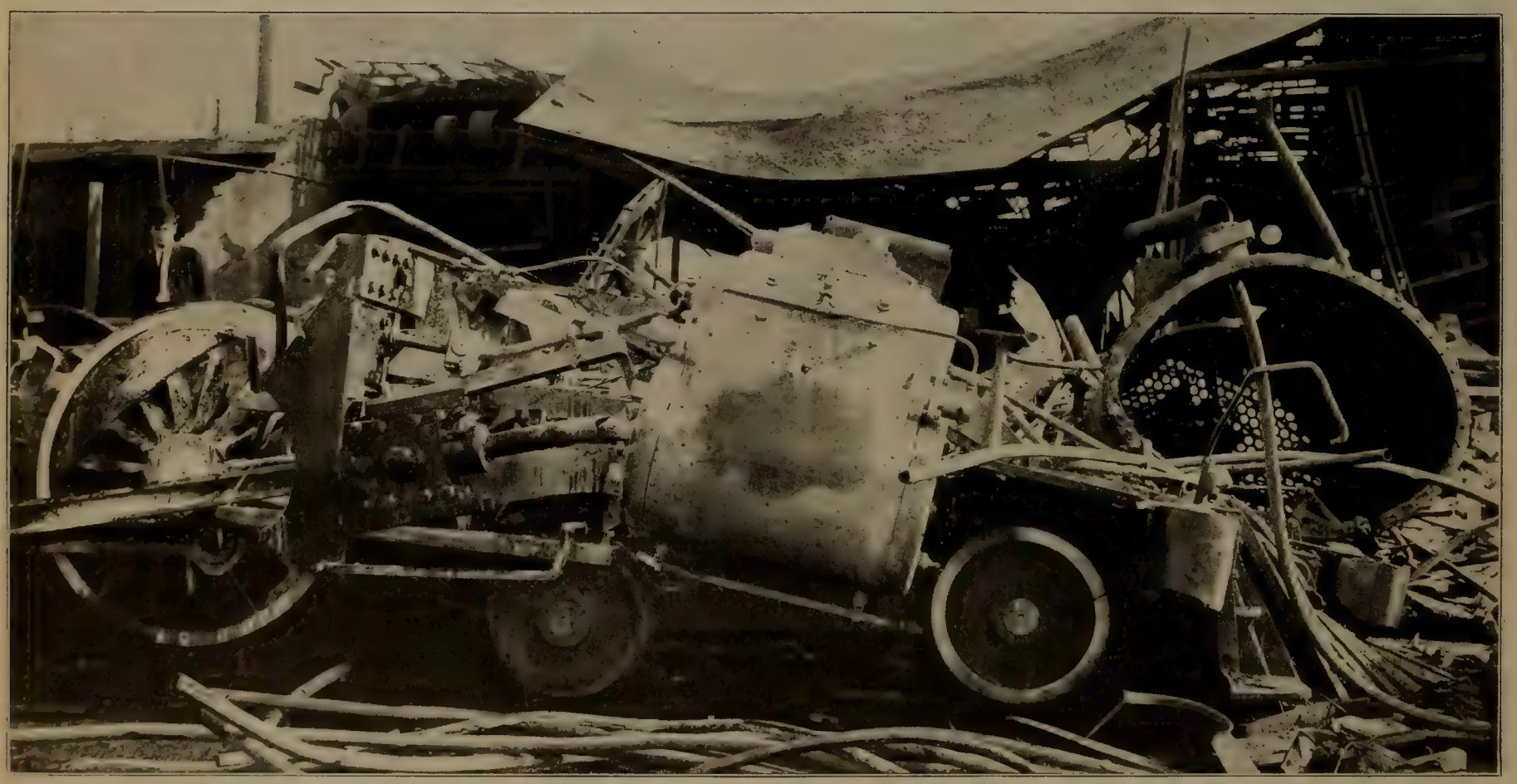


Fig. 5.—Front End, Showing Bent Frame and Broken Piston. Front End of Boiler is Shown at Right Angles to Frame.

might be caused by holes in the fire, working engine very hard and then suddenly shutting off steam and leaving shut off for some time, cold water from injector falling to bottom of boiler and to washing boilers with cold water. Proper firing will take care of the holes in the fire. There are hilly divisions of such character that it is necessary to work engine very hard up to top of grade and then drift down to bottom, and, unless the flues are kept free from scale, there will be considerable trouble from leaky flues under these conditions. Numerous arrangements are in use for preheating the water entering the boiler, and Figure 1 shows a cheap, simple and effective device for doing this. This is simply a cast iron elbow screwed into the boiler check and pointed upwards so that the water from injector shoots up and is heated as it enters the boiler instead of dropping cold to the bottom. With this upturned elbow the difference in temperature between the water in the bottom of the boiler and near water level will only be about 10 degrees Fahrendegrees Fahrenheit, whereas with a heavy coating of scale these would get as hot as 1,000 degrees Fahrenheit, or even hotter. The remedy for most of the trouble then is to prevent overheating by avoiding the scale formation, and this is done by proper chemical treatment of the feed water.

It is not intended to assert that water treatment is the absolute cure for boiler troubles; the boiler work must be done right. For example, one thing that is liable to keep flues leaking is the misuse of the beading tool. If this tool is held incorrectly, as is the tendency in working the lower flues (which are also the ones most liable to leak), these flues, though the leaking is stopped temporarily, will soon start again when engine goes out on road. The bead may be set up against the sheet all right; but the joint in the flue hole, which to prevent leaking should be good, is gradually made worse and worse until it is nearly impossible to keep flues tight. With proper water treatment, there may be leaky flues due to careless boiler work, but if water treat-

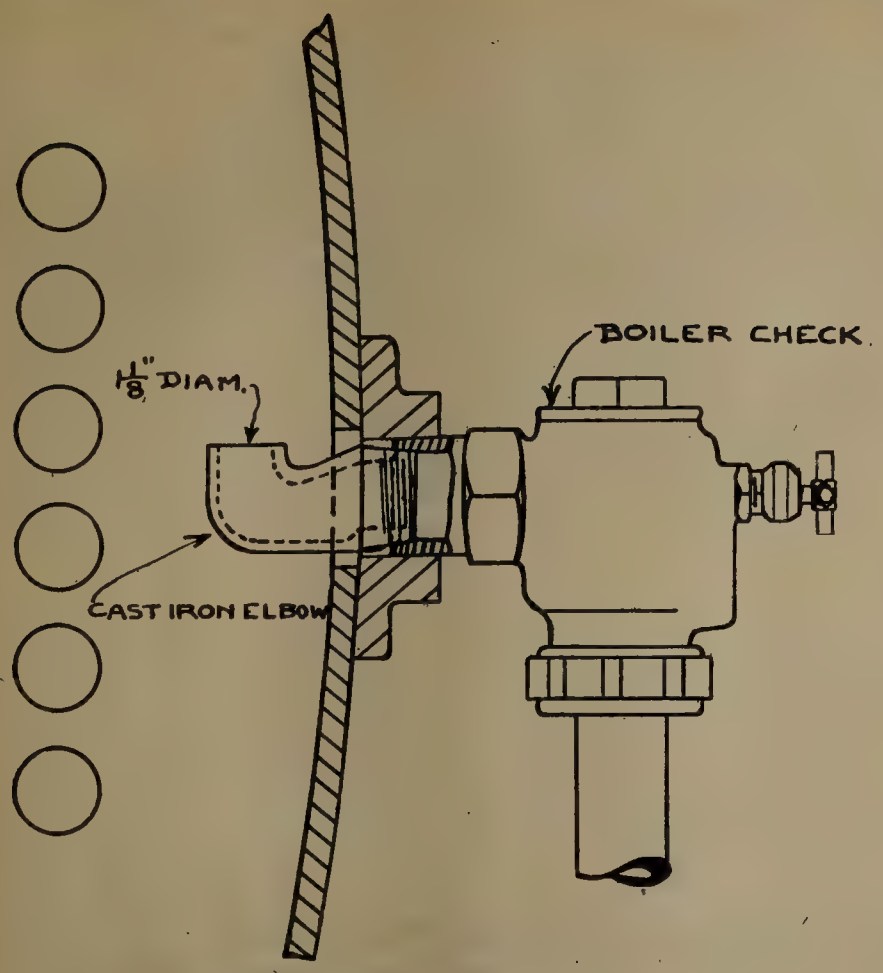


Fig. 1.—Upturned Elbow and Extension for Boiler.

ment is insufficient to prevent flues from scaling they are very liable to leak even with the best of care by the boiler maker.

I think all will agree that where waters that do not form scale are used boiler troubles are rare, and if we haven't such waters the obvious thing to do is to put the waters that we do have in a non-scaling condition.

Treatment.

There are then two evils that are to be counteracted in a boiler water, the tendency to form scale and the tendency to foam. To remove the scaling tendency several different kinds of water softeners are in use. These use slaked lime to precipitate the carbonates of lime and magnesia, and soda ash to treat the sulphate hardness; so that the resultant water as delivered to boilers, if the water softener is designed to allow plenty of time for chemical reaction and settling and is properly looked after, contains only about six parts per 100,000 of total hardness, and is also cleared of most of whatever mud may have been in the original water.

Experience has shown that if waters are treated with enough soda ash to neutralize the sulphate hardness and provide enough excess to have it amount to about 15 per cent of the total dissolved solids in the water from the boiler, all of the scale forming material, both carbonates and sulphates, although it goes into the boiler, will be converted into a soft sludge which can be blown out through a properly located blow-off, and there will be no scale formation with its attendant boiler leaking troubles. Soda ash or sodium carbonate is one of the alkali salts that exists in some waters naturally, but it does not exist in the same water with sulphate of lime as the two would react to form sulphate of sodium and carbonate of lime. If then, a water containing sulphate of lime is treated with soda ash this same reaction takes place, perhaps partly in the supply tank but mostly in the boiler, and the carbonate of lime is thrown down as a mud while the sodium sulphate stays in solution, thereby increasing the alkali salts or foaming tendency of the water.

As pointed out before, when the concentration of the alkali salts, which include the natural alkali in the raw water and that added as soda ash, reaches a certain point foaming results. This foaming point varies with different types of boiler and also with the height of water carried in the glass, but in districts where surface supplies carrying more or less suspended matter are used, boilers are usually in a foaming condition when the total dissolved solids in water taken from the boiler are over 200 parts per 100,000. Where only well waters are used this limit will be about 250 parts per 100,000 or even higher. When the foaming point is reached either the boiler is washed, the water changed, or part of the concentrated water is blown out and replaced with fresh water, this being done often enough to always keep the total dissolved solids below the foaming limit of 200 or 250 parts per 100,000 as the case may be.

The mud and carbonates precipitated in the boiler if allowed to accumulate may cause trouble in three ways:

1. The foaming tendency of the water in the boiler increases.
2. Heavier scale will form at times when treatment is light.
3. There is danger from mud-burning.

It is essential, therefore, that engines using treated water be equipped with suitable blow-off arrangement for removing this sludge from the boiler. The circulation of water in the locomotive boiler is along the bottom toward the back water leg where it is least rapid; and all solid particles light enough to be moved by the current are carried back toward that point. When there is scale formation in the boiler the heavier pieces of scale drop out in the belly and in the front of the side legs while the lighter scales and mud are deposited in the back of the side legs and in the back water leg.

If the water has been treated with the proper amount of soda ash there will be practically no scale formation, and the lime and magnesia carbonate sludge will deposit in the back water leg from which it can be removed by means of a perforated pipe extending across and lying on the back mud ring and connected to a blow-off cock located in the back corner. Such an arrangement is shown in Figure 3.

Where muddy waters are used, a great deal of the mud can be kept out of boilers by equipping the supply tubs with float pipes so that water going to water cranes or down spouts is always drawn from near surface of water in tank. Advantage is thus taken of the natural settling of the mud in the water.

The primary purpose of the blow-off cock where soda ash is used is to replace part of the highly concentrated water in the boiler with fresh water from the tank in order to keep the total dissolved solids in the water below the foaming point. Although the removal of the sludge and suspended matter in the boiler is important it is incidental to keeping the concentration of the dissolved solids down; but the blow-off cock has to be used often enough for the first named reason to keep the boiler always in good condition from the sludge standpoint. Where fully treated water is used and engines are equipped with this blow-off arrangement, engines, if systematically blown off, can be kept in good condition and will run indefinitely without having to wash out boiler. This has been demonstrated

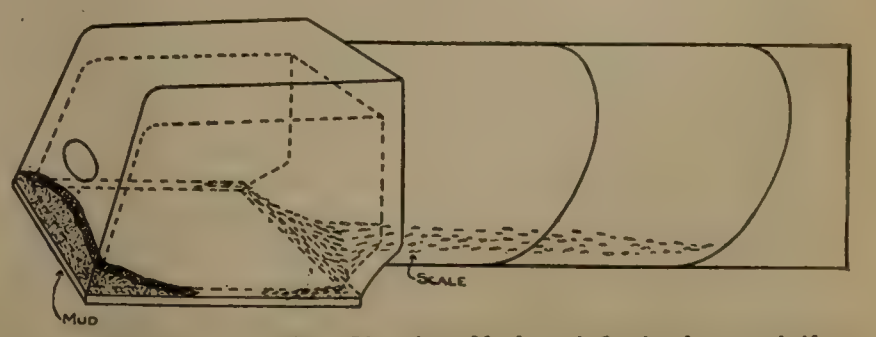


Fig. 2.—Sketch of Boiler, Showing Mud and Scale Accumulations.

by tests and in practice. One division that has treated water and has given this matter considerable attention, averaged for one year, 4,000 miles per washout for all engines on the division.

It is, of course, not advisable to run very far without washing if water is not treated fully and continuously enough to prevent scale accumulation. It is difficult to get out of the habit of washing engines every two or three trips, but where treatment is complete and properly looked after there is no reason for taking the water out of the boiler except through blowing off and at the stated period when the Federal Law says the boiler must be washed.

The mere fact that water has been treated with soda ash does not make it a badly foaming water. The average Illinois water treated does not contain as much alkali and therefore has not as strong a foaming tendency as the Nebraska water untreated, and an engine will reach the foaming point and need blowing off or water changed sooner when it uses the waters higher in alkali whether that alkali is there naturally or whether it was introduced in the form of soda ash.

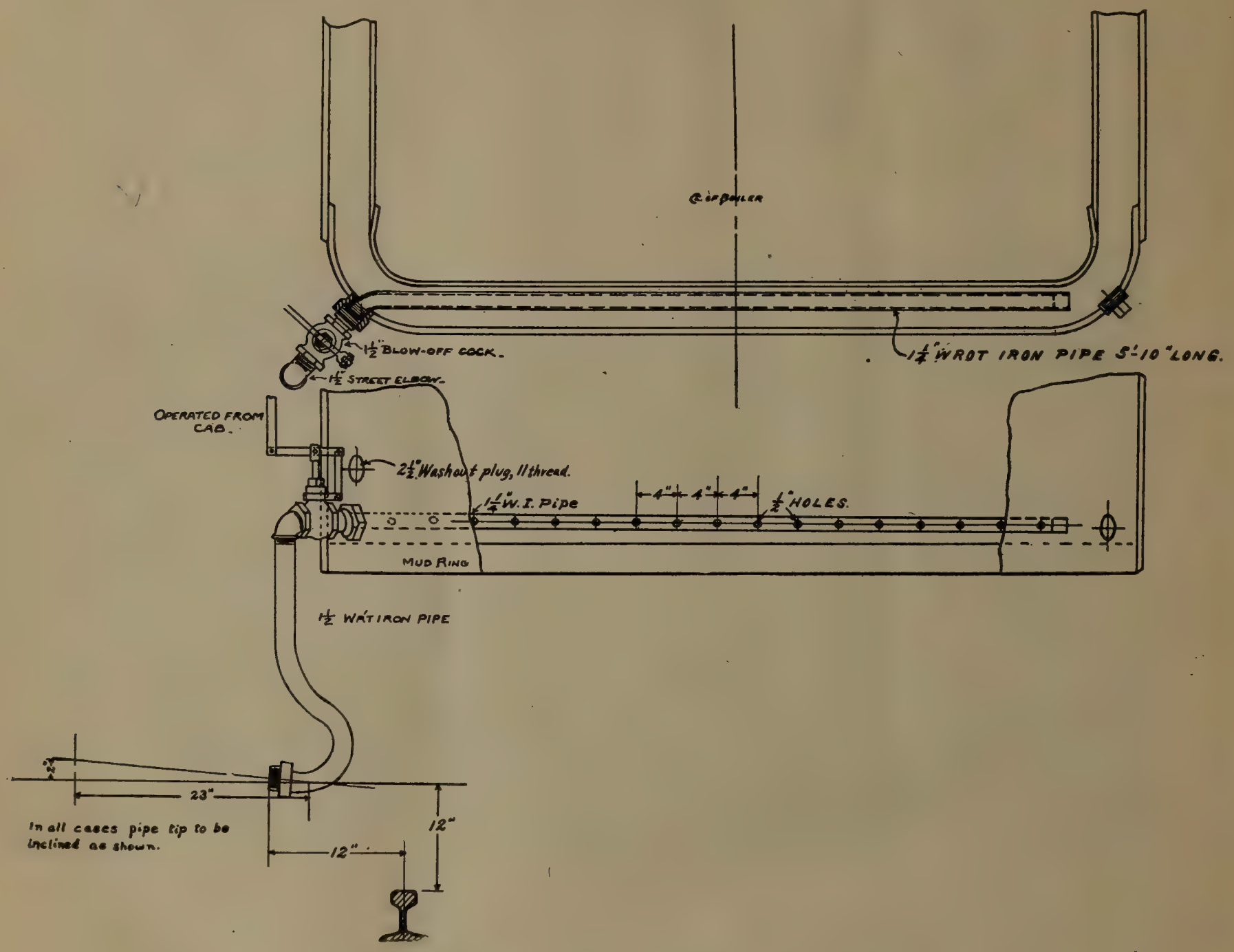


Fig. 3.—Back Water Leg Blow-Off. Pipe, for Wide Fire Box Engine.

Amount of Blowing-out Necessary.

The amount of blowing off that has to be done to keep water in boiler below foaming point of 200 or 250 parts per 100,000 depends on the amount of water used, the amount of soda ash used, and the natural alkali in the raw water. Stream waters in Illinois contain perhaps two parts natural alkali and are treated with eight parts soda ash (this corresponds to 2/3 lb. soda ash per 1,000 gallons), making a total of ten parts alkali salts per 100,000 in the water as fed to the boiler, so that when $\frac{200}{10} = 20$ boilers of water are evaporated water will be at the foaming point, and it is necessary to either change the water completely or do enough blowing to prevent concentration rising over 200; in this case to effect this result it will be necessary to blow away $\frac{10}{200}$ or 5 per cent of the water used. At 15,000 gallons water used per 100 miles, this will mean 750 gallons, and as a 1½-in. blow-off cock under 200 lbs. pressure will let out about 150 gallons per minute, a total blowing of $\frac{750}{150}$ = five minutes will be necessary to keep boiler from foaming. A minute's blowing on heavy power is about two inches in the glass, five minutes means 10 inches, and this may be done at terminals or on road. Passenger engines ordinarily can be blown enough at terminals to keep them in good condition indefinitely, but freight engines will have to have more or less blowing done on the road as well as at terminals. Where heavy and frequent blowing is necessary operating conditions do not always permit blowing in time and then engine works water. An instance of this sort is where there is a continuous upgrade for 150 miles, water runs high in alkali necessitating heavy

blowing, and about the only time freight engines can get ahead enough on water to do the blowing is where they stop at stations. Heavier blowing out has to be done as the total of natural alkali and alkali added as soda ash is higher, and with waters on some divisions the necessary blowing would more than offset the saving in cost of washout and advantage of not holding engine for washout. When this limiting condition is reached it will be cheaper to change water with an occasional washout than to rely entirely on blowing out. There are worse conditions than this, for some waters will run so high in alkali that the use of an anti-foaming compound which raises the foaming point of the water to perhaps 600 parts per 100,000 is necessary for engine to make even one round trip without foaming trouble.

Cost of Blowing-out.

The amount of coal wasted at blow-off cock per one minute of blowing would be 50 lbs., figuring 150 gallons = 1,250 lbs. water blown out per minute and that one pound coal will heat 25 lbs. of water to the temperature of water leaving blow-off cock. With coal at $2.00 per ton and water at 5 cents per 1,000 gallons this would amount to $0.05 per minute for coal and $0.0075 for water, a total of $0.0575.

There are several objections against extensive use of the blow-off cock on the road. In passenger service it is impractical to open the blow-off cock on the road, and in freight service it is objectionable on account of heavy drain on boiler in small space of time, whitewashing company property and complaint because of noise and dirtying of property of people residing along the line. Where the country is fairly closely populated and in a number of towns people object so strenuously to the noise and splash of the blow-off cock that it has been necessary to issue orders not to use it at these places, and enginemen often find themselves hard put for an opportunity to blow their boilers. Blow-off boxes so located at intermediate water stations that engine can be blown while taking water relieve the situation materially, but what promises to help solve the problem is the use of a blow-off cock with opening so restricted that instead of a large amount of water being let out of boiler in a short space of time the blowing goes on continuously for an hour or more as the condition demands. An opening ¼ in. in diameter will allow about 450 gallons or six inches in the glass to leak away in an hour, and this seems to be a satisfactory size for the continuous blow-off. Where the necessary blowing per 100 miles is 750 gallons, the ¼-in. blow-off cock, if kept open $\frac{750}{450} = 1\,2/3$ hours, would keep the boiler in good condition without having to use main blow-off cock at all. About the only time when it is impractical to use the ¼-in. blow-off is when engine is working hard up-grade, and taking all the water one injector will supply; but there is usually plenty of opportunity over the division to use it all that is necessary.

The primary purpose of a blow-off cock is to get rid of the concentrated water in the boiler; the ¼-in. blow-off cock does this and actual test has shown that if properly located it also carries away a great deal of the suspended lime sludge. A Pacific type passenger engine with one of these ¼-in. cocks in back corner near mud ring and with regular blow-off cock disconnected so that it could not be used made, experimentally, 10,000 miles in fast passenger service without washout or change of water. The average treatment of the water used was ½ lb. soda ash per 1,000 gallons, the average total hardness was about 28 parts per 100,000 (or 16 grains per gallon), yet when boiler was opened for washout it was practically clear of sludge and had only small deposits of old scale in the side water legs. Blow-off cock was kept open about two hours over a 150 mile run. The experience has been that small valves soon cut

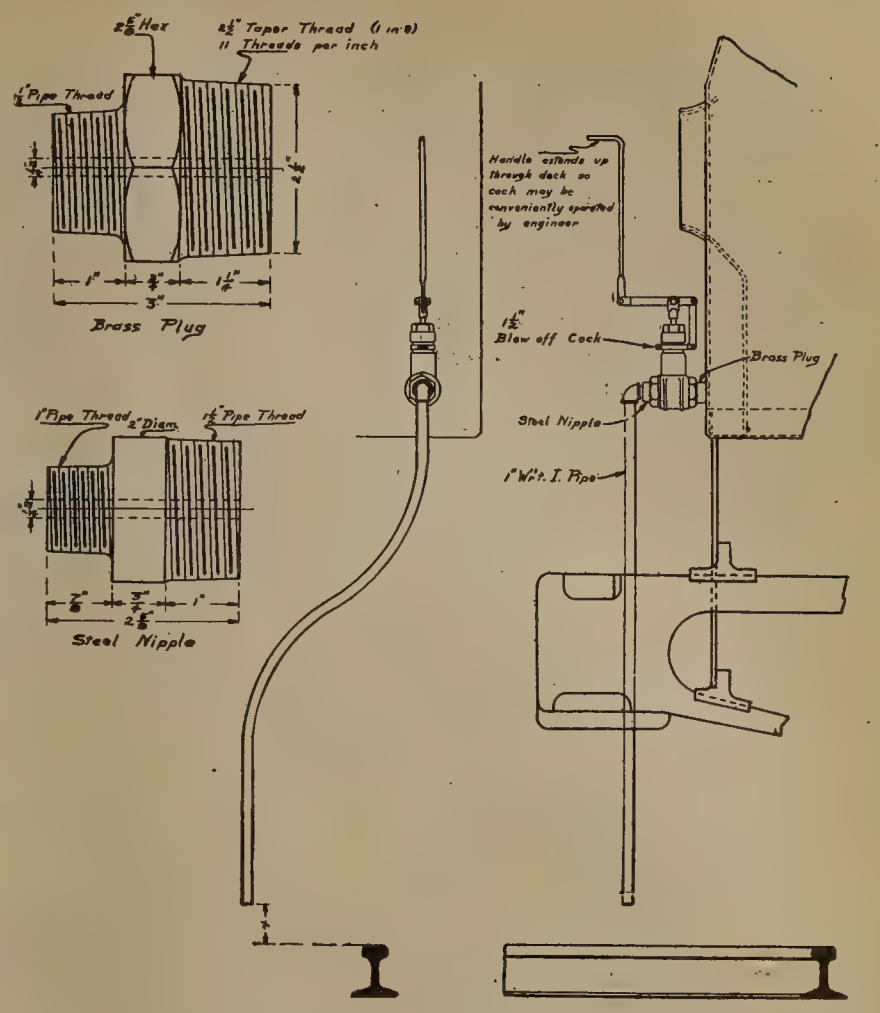


Fig. 4.—1¼-inch Blow-Off Arrangement.

out, and the best arrangement is the ordinary 1½-in. blow-off cock with bushing bored out ¼ in. in diameter. Figure 4 shows this arrangement.

The reason for dwelling at such length on the blowing off is that the success of soda ash treatment in a large measure depends upon it. The use of soda ash increases the foaming tendency of the water, and when the foaming point is reached, if the water is not gotten rid of through the blow-off cock it will depart via the cylinders and valves, causing heavy use of oil, dissatisfaction of the enginemen and various machinery failures.

Procedure in Starting Soda-ash Treatment.

How then shall a certain division be equipped to avoid boiler troubles? We must first get the best available water supplies; second, provide suitable arrangements for blowing off engines and line up to have engines blown systematically at terminals and on road; third, treat all waters containing sulphate hardness with the necessary amount of soda ash; and fourth, provide sufficient chemical inspection to maintain correct treatment at all times.

Water Supplies.

Chemical analyses of the waters in use for locomotives should be made, and where the sulphate hardness or the alkali salts are high an effort should be made to locate a better supply that can be substituted at a not prohibitive expense. Often water is taken from a well at the bank of a stream and is much harder water than the stream water; it is easy here to discontinue well and pump from the stream. Open dug wells will furnish bad water when bored wells of the same depth will, by excluding surface water, furnish a good water. Bored wells tapping different rock strata furnish waters of different qualities, and the well giving the best quality should be used, casting off any objectionable waters from other strata. Frequently the underground waters at a station may all be bad, and the artificial surface reservoir is a good solution of the problem (as it will usually furnish a fairly good grade of water). The quality of the water from a surface reservoir depends on the character of the ground on the drainage area; if there is much limestone, gypsum or alkali on the drainage

area as is often the case between Western Nebraska and the Rocky Mountains and in some cases further east, the water that collects in the reservoir may be very bad. This is contrary to a prevailing belief that rain water being soft, the reservoir water will also be soft. Analyses of a number of samples of run off water from drainage area of proposed reservoir should be made to determine the probable fitness of the water before building the dam, otherwise considerable money may be spent in getting a water supply that will be unusable for boilers.

For every six parts of alkali salts per 100,000 a cent's worth of coal at $2.00 per ton will be wasted at blow-off cock per 1,000 gallons water used, in order to keep water in the boiler below foaming point of 200 parts per 100,000.

With the better water there would be a saving in cost of soda ash and coal wasted in blowing off of six cents per

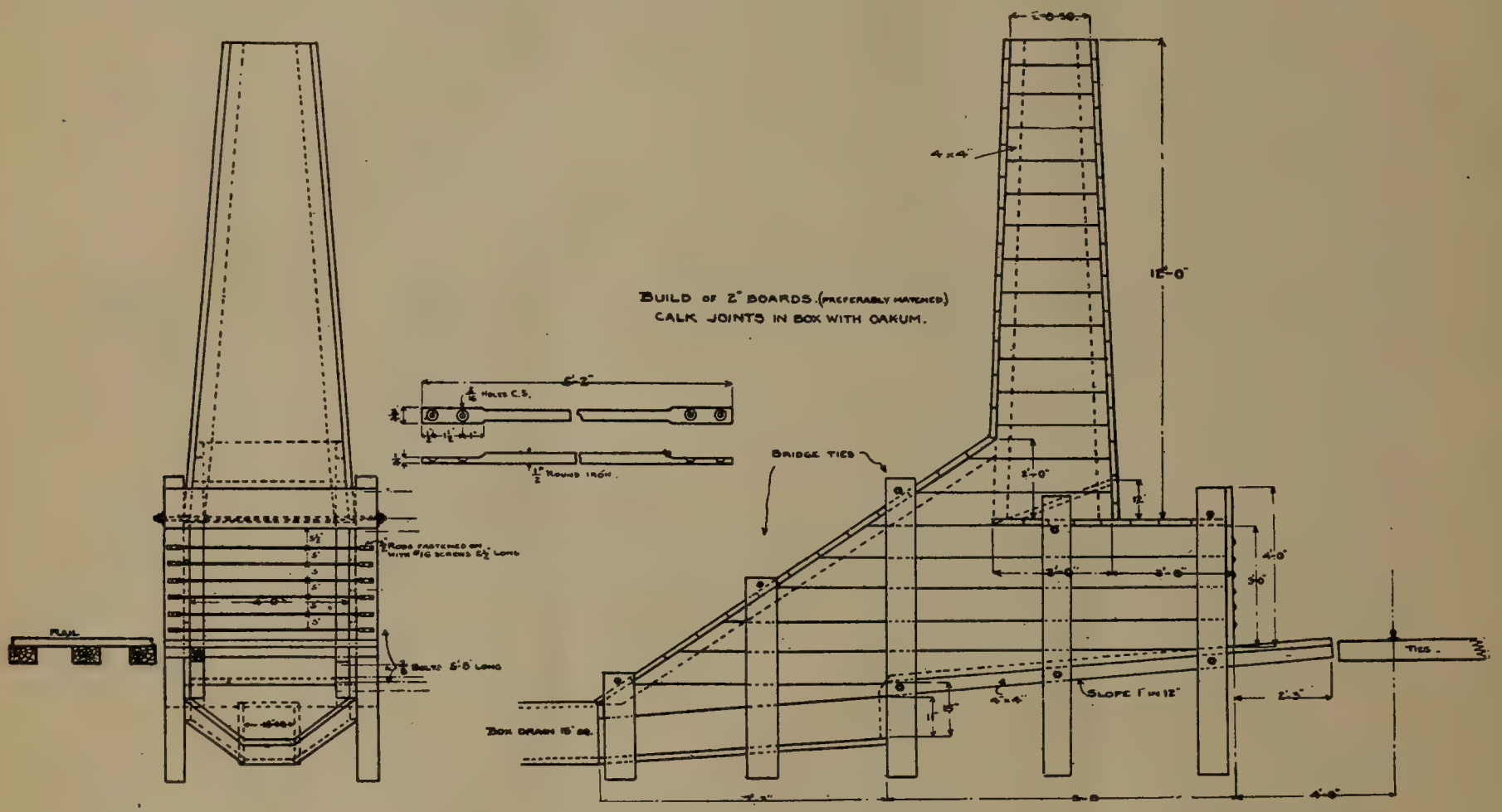


Fig. 5.—Blow-Off Box for Terminals.

1,000 gallons, much less blowing would be necessary, and there would be less liability to boiler troubles if treatment were neglected or stopped temporarily.

Blowing-off Boilers.

The proper blowing off of engines where water treated with soda ash is used is of utmost importance to avoid foaming failures and excessive use of valve oil, and it is wise to have this lined up pretty well before starting the soda ash. At terminal roundhouses there should be a place for blowing off engine just before it goes onto clinker-pit, and it is also a good plan to provide a similar arrangement on outgoing track to give enginemen opportunity to blow off before leaving. Pipe from blow-off cocks should be located the same on all engines and the end of pipe provided with a threaded nut to enable it to be connected to a steam hose. Then a blow-off box may be used, or where the noise or steam is objectionable engine may be blown through a hose into a sump. Terminal blowing may be done by hostlers or at important terminals there may be one man whose duty is to blow a full glass of water from every incoming engine.

Figure 5 is the open blow-off box and Figure 6 is the sump.

Treatment.

All waters containing sulphate hardness should be treated with enough soda ash to neutralize this sulphate and have treated water show excess of sodium carbonate from one to four parts per 100,000. This excess should be such that waters taken from boilers of road engines will have 15 per cent or more of the total dissolved solids as sodium carbonate (soda ash). The soda ash solution would best be introduced evenly and continuously and should go through separate pipe into the water tank so there will be a chance for chemical reaction before the treated water passes into any pipe lines. With practically all water, putting the soda ash solution into the discharge pipe from main pump will result in liming up of this pipe, which sooner or later results in closing the pipe to such an extent as to necessitate cleaning it out or laying a new pipe.

Any of the following plans may be used for introducing the soda ash:

1. Steam pumping station with tank within 800 feet.

Connect small plunger pump to main pump and pump soda ash solution from 100 gallon galvanized iron tank through 2-in. pipe to supply tank; or, use small duplex steam pump to pump solution from a 300 to 600 gallon solution tank.

2. Gasoline engine pumping station with tank within 800 feet.

Connect small plunger pump direct to main pump or run it by eccentric or extension shaft and pump solution as in (1).

3. Tanks at terminals where city water is used or where pumping station is remote.

(a) Use small duplex steam pump as in (1) and pump solution continuously.

(b) Where compressed air is available force soda ash solution from closed tank continuously to supply tank. Solution pipe runs to top of the supply tank to give constant back pressure and the air to solution tank passes through a reducing valve that maintains a constant pressure 5 lbs. greater than the back pressure. Solution is forced through a perforated metal gasket, the amount of flow required being governed by size of perforation. This is preferable to the pump as it forces the solution evenly and the only attention needed is to mix the solution every 24 hours.

4. Pumping station and supply tank over 800 feet apart or where city water is used.

(a) All water pumped passes through a large water motor which operates a plunger pump to pump the soda ash solution to supply tank. This is in a building close to tank and must be provided with heat in winter.

(b) Figure 7 shows an automatic treating plant with no moving parts to get out of order and one that needs only the attention of charging every 24 hours. It is located in a house near supply tank. Its operation is as follows:

There is an open tank for mixing soda ash, a closed soda ash tank and a closed air reservoir. A perforated metal gasket in main pipe line causes a difference in pressure of about 4 lbs. between the two sides of this gasket. Size of hole in gasket can be calculated from average flow of water. A pipe leads from high pressure side of gasket to air tank. The air pressure created there is transmitted through a small pipe to top of closed soda ash tank and forces solution through a gasket with small hole to supply tank through separate soda ash line. Charging plant consists

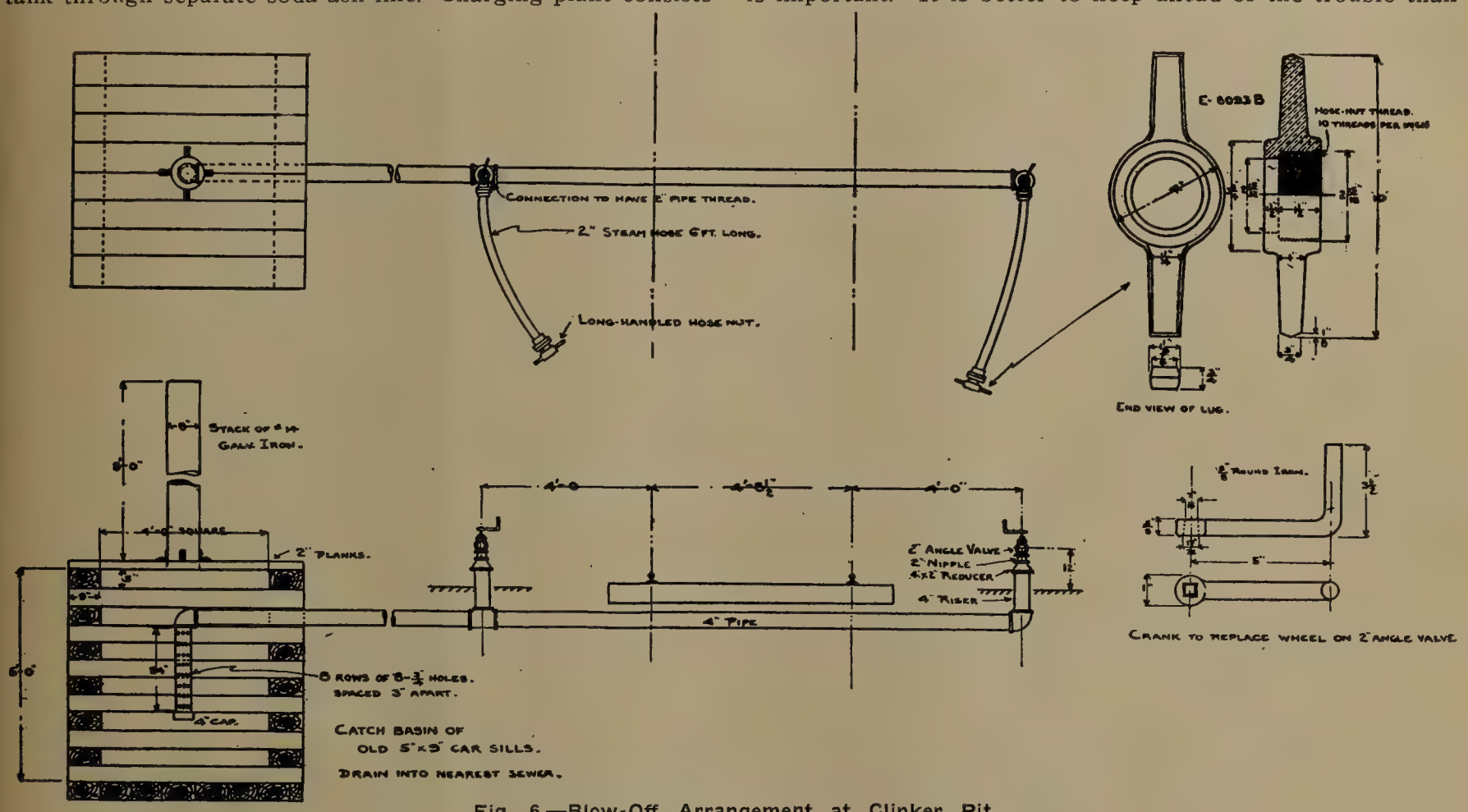


Fig. 6.—Blow-Off Arrangement at Clinker Pit.

of emptying air tank of accumulated water, mixing soda ash in open tank and letting it into closed soda ash tank. Flow of solution is regulated by size of hole in gasket in soda ash line so that plants will run 24 hours to one charging.

5. At tanks where little water is used fairly even results can be obtained by suspending the soda ash every 12 or 24 hours in a burlap sack in supply tank. It is difficult to get this done in severe weather and the method is unreliable.

Supervision of Treatment.

A very important feature of treating waters with soda ash alone is to provide enough chemical inspection and supervision to insure keeping all waters treated fully and with as little interruption as possible. If the treatment is a little light on account of neglect of pumpers or insufficient soda ash called for in directions so that the treated waters in general still show some sulphate hardness, then the only benefit is in the small decrease in hardness of the water, due to some precipitation of the lime carbonate in the supply tub. The foaming tendency of the water will have increased in proportion to the amount of soda ash used, and boiler must be blown off nearly as much as with full treatment; but the hard scale still forms on the flues and causes the leaking troubles that the soda ash is expected to cure. To keep treatment right a road water inspector should make frequent analyses of the raw and treated waters for sulphate hardness or sodium carbonate and should also inspect apparatus for treatment. If this inspection shows treatment wrong he should do what he can on the ground toward adjusting matters, and report to division officials when other steps are necessary to correct pumper or repair apparatus. Men handling the soda ash treatment, whether pumpers, agents or section-men, should be lined up to report at once to superior officer whenever for any reason the soda ash cannot be used properly, and the complaint should be given prompt attention and necessary repairs made. On some divisions the interruption of correct treatment even for a short time causes an epidemic of leaky boilers, and it is on divisions like this where frequent chemical inspection is important. It is better to keep ahead of the trouble than it is to have trouble and then send a man to locate the cause. On some divisions where the raw waters do not vary much in quality at different times of the year and where there is a dependable class of men handling the soda ash, it will not be necessary to provide so much chemical supervision after treatment has been started and is going satisfactorily, and one water inspector may be able to handle two or three such divisions. On other divisions where the waters vary considerably in quality, where the pumpers, etc., are changing frequently or where slight falling off in treatment is followed quickly by boilers leaking, it pays to keep a water inspector on the division all the time.

The best criterion of the condition of the treatment over any part of the road is gotten from the analyses of waters taken from boilers of road engines. These waters can be collected by the roundhouse force, properly tagged and sent to the laboratory to be analyzed for total dissolved solids and for sodium carbonate. If the total dissolved solids are above the 200 or 250 parts per 100,000 according to the locality, then not enough blowing is being done to keep water

in boiler from foaming condition; this will sometimes show that certain engineers are neglecting the blowing and they can be instructed accordingly. If the soda ash is below 15 per cent of the total dissolved solids the treatment is light somewhere, and inspector can make necessary increases in soda ash or perhaps locate some neglect. The following form shows a method of reporting to division officials results of these analyses.

To ———— *M. M., Chicago, Ill.:*

I have analyzed samples of water collected at Chicago, Ill., taken from boilers and find as follows, results expressed in parts per 100,000:

Eng.	From	Date. 1911.	Total Diss. Solids.	Total Hardness.	Sodium Carbonate	Per cent. Sod. Carb. to Total Dis. Solids	Engr.
1952	Chicago	11-20	242	1.5	36.5	15.0	Scott
1960	"	"	230	1.4	50.6	22.0	Perkins
1910	"	11-19	270	1.6	37.4	13.3	Marshall
1941	"	11-20	202	1.7	30.3	15.0	Dur
2903	"	11-13	234	3.3	32.7	13.9	Bosworth
1952	"	11-12	218	3.0	33.0	15.1	Ray
2802	"	11-13	219	1.8	45.2	20.6	Monks
2848	"	"	193	2.1	41.9	21.7	Brown
2809	"	"	174	2.6	37.4	21.4	Ford
1927	"	11-12	251	1.8	35.2	14.0	Radcliffe
1959	"	11-13	246	2.5	29.5	11.9	Canfield

Remarks.—To prevent scale formation and leaking flues waters should be treated so that there will be over 15 per cent sodium carbonate to total dissolved solids. To prevent foaming enough blowing should be done to keep total solids below 250 parts per 100,000.

Results of Treatment.

The advantages gained by full and systematic treatment of water are as follows:

1. Engine failures due to leaky boilers are reduced to a minimum. On divisions where soda ash treatment has been in use for several years the records show an average mileage per engine failure, due to leaky flues of 513,000 miles. The total yearly mileage on these divisions is about 10,000,000, all waters are treated and most of the engines are heavy power with flues 19 and 21 feet long.

2. Much less boiler work is needed, mileage of flues between shopping is materially increased and the cost of boiler repairs is correspondingly decreased. It is not necessary to shop an engine for flues before the machinery needs it.

3. Mileage between washings of boiler is increased.

4. There is a saving of fuel due to having boiler free from scale. Also a saving of the fuel that heats the water lost from leaking boilers.

5. Engine is not held out of service so much for washing and working on boiler.

The disadvantages are the increased foaming tendency of the treated water and the waste of coal and water in blowing off to overcome this foaming tendency.

The cost of water treatment can be given fairly closely, but it is rather difficult to give in dollars and cents the various savings due to treatment. Some estimates of these costs and savings are given here as so much per engine per year.

Cost of Treatment.

Soda-Ash.

The average amount of soda ash used per engine per year on divisions with modern treatment will be about 1,700 lbs., which at a cent a pound will be $17.00 per engine per year.

Coal Wasted at Blow-off Cock.

Every pound of soda ash used per 1,000 gallons of water increases the alkali salts by 12 parts per 100,000 and when 17 lbs. have been used the foaming point of 200 parts is reached and water must be blown out. Therefore for every pound soda ash used 1/17 of 1,000 gallons of water = approximately 500 lbs. of water must be wasted at blow-off cock, and assuming that 1 lb. coal heats 25 lbs. of water to the boiling point at 200 lbs. pressure, it will take 20 lbs. of coal. With coal at $2.00 per ton this will cost two cents per lb. soda ash or $0.02 × 1,700 = $34.00 per engine per year.

Water Wasted at Blow-off Cock.

As each pound of soda ash used requires blowing out 1/17 of 1,000 gallons of water, 1,700 lbs. would require blowing out 100,000 gallons, which at 5 cents per 1,000 gallons, would be $5.00 per engine per year.

Supervision.

The cost of supervision of treatment, including chemical inspection will not amount to over $10.00 per engine per year and should decrease as the efficiency of keeping up treatment increases.

Blowing-off at Clinker-Pit.

Extra labor may be employed at some terminals for blowing out engines. This charge and the cost of maintaining blow-off hose at the various clinker-pits will be about $5.00 per engine per year.

Savings.

Boiler Repairs.

The saving that can be made in cost of boiler repairs will vary for different localities and depends on the quality of the waters in use on the division to be treated. Where the waters are bad the heavy boiler work necessary means high cost of boiler repairs, and water treatment will result in a much larger saving than on divisions where the waters are of good quality and the expense of boiler work is ordinarily not high. An estimate of the average possible saving in cost of boiler repairs, running and general, will be $250.00 per engine per year. This may be high under some conditions, and low for others.

Fuel Saving.

There are various estimates as to the amount of fuel saved by clean flues versus flues with scale of different thickness, and tests of locomotive boilers have shown a saving of 10 per cent in clean flues over flues with 1/16-in. scale. As boilers using untreated waters start out of shop clean, and even after scaled some of the scale is continually cracking off, the average saving of fuel would probably not be as high as 10 per cent. It seems as though 3 per cent is a conservative estimate and with an average fuel bill of $4,000.00 per engine per year this would amount to $120.00.

Washing Boilers.

Where waters are properly treated and engines are equipped with blow-off pipe in back water leg it is practical to run boilers the month allowed by the Federal Law (this is true in general but does not apply to divisions where the natural alkali in the water is so high that a change in water is cheaper than blowing off). If engines receive ordinarily forty washouts per year at a cost of $1.50 per wash or $60.00 total, two-thirds of this can be saved or $40.00 per year.

Increased Service.

An engine is out of service due to running repairs, general repairs and boiler washing probably 15 per cent of the time, or 54 days per year. Some of this is due to boiler work alone and decrease in boiler work ought to cut this down by 10 days. An engine is worth $20.00 a day when power is scarce, but as at times of the year engines might not be needed though available, I will estimate this saving as five days at $20.00 per day, or $100.00 per engine per year.

Summary.

Cost Per Engine Per Year.

Soda ash, 1,700 lbs. at 1 cent per lb.	$17.00
Coal wasted, 17 tons at $2.00 ton	34.00
Water wasted, 100,000 gal. at $0.05 per 1,000	5.00
Supervision of treatment	10.00
Blowing a clinker-pit	5.00
Total cost	$71.00

Saving Per Engine Per Year.

Boiler repairs	$250.00
Fuel 3 per cent of $4,000	120.00
Washing boiler	40.00
Ten days' extra service at $10.00 per day	100.00
Total saving	$510.00
Net saving per engine per year	439.00

The above estimate shows a net saving per engine per year of $439.00, and when multiplied by a large number of engines this amounts to a great deal of money. Another saving that is not estimated is the saving in delay to freight and the cost of sending out another engine and crew to haul

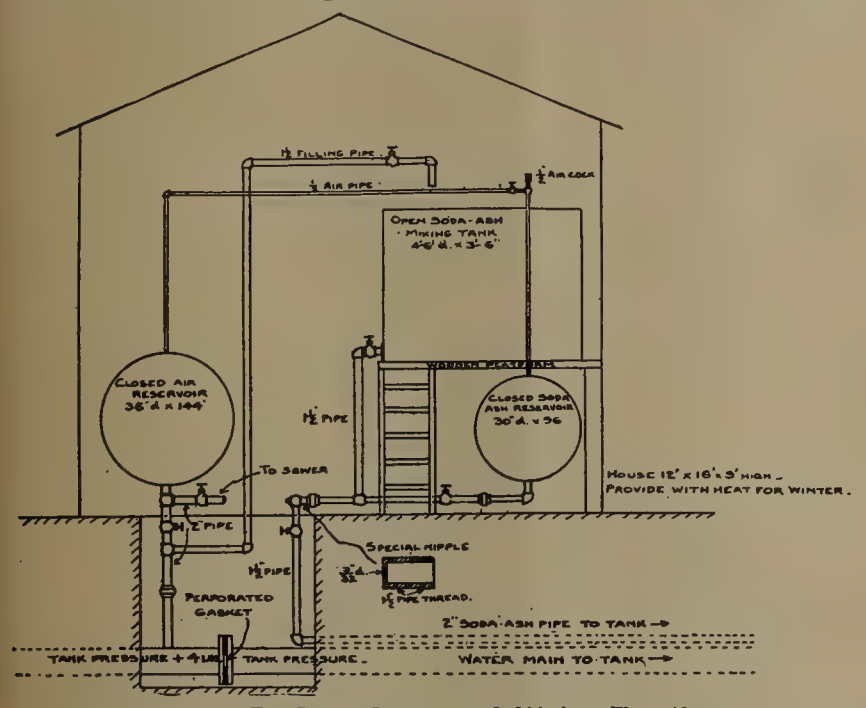

½ FILLING PIPE
¼ AIR PIPE
¼ AIR COCK
OPEN SODA-ASH MIXING TANK 4'6" d. x 3'6"
CLOSED AIR RESERVOIR 36" d. x 144"
CLOSED SODA ASH RESERVOIR 36" d. x 96
1½ PIPE
TO SEWER
HOUSE 12' x 16' x 9' HIGH - PROVIDE WITH HEAT FOR WINTER.
1½ PIPE
SPECIAL NIPPLE
½ PIPE
PERFORATED GASKET
½ PIPE THREAD.
2" SODA-ASH PIPE TO TANK
TANK PRESSURE + 4 LBS.
TANK PRESSURE.
WATER MAIN TO TANK

Fig. 7.—By-Pass System of Water Treating.

in a train whose engine has died on account of leaky flues.

In conclusion: it is necessary in order to prevent boiler troubles and insure getting results from water treatment to:

1. Secure best available supplies.
2. Line up enginemen and terminals to blow off boilers systematically and sufficiently to keep ahead of foaming troubles.
3. Give all waters containing sulphate hardness the necessary soda ash treatment and provide enough chemical inspection and general supervision to keep treatment full and continuous.

Soda ash treatment has been condemned and abandoned because of foaming troubles or failure to stop boilers leaking, and I wish to emphasize the importance of blowing off, the remedy for foaming, and of giving the treatment enough attention to keep it full and uninterrupted. If these things are done the treatment will pay large returns and will be well worth while.

C. W. Stark has been appointed supervisor of mechanical instruction and examination for enginemen on the Eastern district of the New York Central & Hudson River, vice D. Cassin, assigned to other duties. J. M. Chaffee succeeds Mr. Stark as road foreman of engines on the Mohawk division.

E. A. Gilbert has been appointed general inspector, motive power department of the Southern Pacific, Pacific system, with office at San Francisco, Cal. Mr. Gilbert was formerly Chicago representative of W. H. Miner Co.

On May first the office of superintendent of motive power of the Atchison, Topeka & Santa Fe was merged in that of vice-president in charge of operation. John Purcell has been appointed assistant to the vice-president with office at Chicago, and will handle mechanical department matter. Mr. Purcell was formerly shop superintendent at Topeka.

In the state of Victoria, in Australia, there has been an altogether unexpected development in railway traffic within the last few years, the passenger and freight business having increased beyond all anticipations. This has resulted in immediate demands for additional haulage power, and 40 engines have been ordered from England and the United States, of which 15 Baldwin locomotives are already in service. An elaborate program of locomotive construction has now been decided on by the Victoria Railway Department, and during the next three years 210 locomotives are to be built in the state. These will be constructed at the rate of 70 per annum—30 at Newport, 20 manufactured in parts by Victorian contractors and erected at Newport, and 20 manufactured wholly by private firms. While it is believed by the department that no Victorian firms will be able to undertake building complete locomotives during the first year, and that it will be necessary to allot such work to firms in other states of the commonwealth, it is thought that by offering inducements for a continuance of the work Victorian firms will be enabled to undertake the construction of the 20 whole locomotives in each of the succeeding two years.

CONSIDERABLE IMPROVEMENT.

(To the Editor of the Railway Master Mechanic)

Barnesboro, Pa., April 16, 1912.

Dear Sir

I acknowledge the receipt of your Post card informing me of your doings, as regards to my new and usefull improvements in Locomotives which issued March 26th, 12. No. 1027455. The nature of my invention is to Economize in Fuel, 2nd to regulate the heat into each and every tube or flue, equally and By the way the arranged flues are set shows its proof. Now for Instance we have the ordinary Fire Box and Boiler, stationary or Loco Bailer, the Question is asked, How many flues or tubes in those Boilers gets the heat. Not ½ of the Tubes or Flues get the heat. Simply Because the heat will always make for the nearest way out to the Atmosphere. Now we will see what a Damper will do. We will place a damper to try to retain the heat in the flues, it is Freed and what do we find, we find it only cuts The heat off the flues and makes its way through the flues where the damper does not cover. So if you look carefully into my invention you will see that a Damper is not necessary for my arranngements. Only at the Tender and the damper at the Back end of the Tender may be dropped right the Low set of Tubes and still it wont cut off any heat from the Tubes in the Boiler. It makes it regular flow from fire box to the stack, through every Tube which is one of the Largest Benefits that has ever came to Locomotive Boiler.

3 Place the heat is retained in the flues or tubes to a extra lengthy time.

4 Place small ash does not escape through the stack.

5 The wasted heat is utilized for make hot water feed.

I send you this copy and specifacations only for the use of the magazine and must not be used any other way only just printing purpose.

To all persons to be cautious not to use you can Publish it I am not against that.

I am not a subsriber to any magazines this year, but I will remember your magazine and the First Dollar I have to spare I give you my name and address, of course you have it now.

Thanking you very very kindly for your favour toward me I remain yours

Very Respectfully,

T—. R—. D—.

P. S. Under a seperate cover I send a copy and specifacation along with this letter.

Loss of the Titanic.

With the sinking of the White Star Line steamship, "Titanic" at 2:20 a. m., April 15, while on her maiden voyage to New York, the world lost among the sixteen hundred passengers reported "missing," C. M. Hays, president of the Grand Trunk and J. B. Thayer, vice-president of the Pennsylvania.

The Titanic was the largest ship in the world. She had a length of 882 ft., width, 92 ft., depth, 94 ft., tonage 46,000. The boat is reported to have cost with its furnishings about $10,000,000. She was proceeding west at a speed of approximately 25 miles per hour and had reached a position south of the Banks of Newfoundland, west longitude 50.14, north latitude 41.46, when an iceberg was sighted simultaneously by the lookout and 1st Officer Murdock who was on the bridge. By reversing the starboard engine and putting his helm hard aport, Mr. Murdock swung the Titanic's bow sharply to starboard. This prevented a head on collision but the port side of the vessel was sharply grazed for perhaps half its length by the sharp edges of the berg. The plates were thus ripped off the side below the water line for a distance of at least three or four compartments, the bulkheads were thus rendered useless and the vessel commenced to sink by the head.

The captain ordered the life boats filled and lowered but owing to the fact that few people were willing to believe the worst, the first three boats were sent away only partially filled. There were twenty boats with a total capacity of about 1,000 people. Less than 750 took advantage of this means of escape for the above reason. The boats were picked up at daylight by the Carpathia of the Cunard Line. This vessel was notified of the Titanic's plight by wireless shortly after the accident and it proceeded to the scene of accident at full speed.

Owing to the low temperature of the water, few who floated on life preservers were saved. Other than those in the boats, there were only several people picked up from rafts and wreckage.

Owing to the fact that the boat was seen to break in two, it was commonly reported that the boilers' blew up as the boat sank, this, of course, was probably not the case. Many steam lines were fractured as the ship's back was broken and the rapid escape of steam would lead to the impression that the boilers exploded. The boat was broken in two as the bow settled and the stern raised from the water.

To the credit of those in charge of the machinery it is stated that the engineers and firemen were on duty at their posts to the last few minutes before the boat sank. The electric lights were kept burning and power for the wireless was furnished until the final sinking.

J. B. Thayer, Jr., son of Vice-President Thayer of the Pennsylvania R. R. who, with his mother was picked up by the Carpathia, made the following statement on April 20:

"Father was in bed, and mother and myself were about to get into bed. There was no great shock. I was on my feet at the time, and I do not think it was enough to throw anyone down. I put on an overcoat and rushed up on 'A' deck on the port side. I saw nothing there. I then went forward to the bow to see if I could see any signs of ice. The only ice I saw was on the well deck. I could not see very far ahead, having just come out of a brightly lighted room. I then went down to our room and my father and mother came on deck with me, to the starboard side of 'A' deck. We could not see anything there. Father thought he saw small pieces of ice floating around, but I could not see any myself. There was no big berg. We walked around to the port side and the ship had then a fair list to port. We stayed there looking over the side for about five minutes. The list seemed very slowly to be increasing. We then went down to our rooms on 'C' deck. All of us dressed quickly, putting on all our clothes. We all put on life preservers, including the maid and over these we put our overcoats. Then we hurried up on deck and walked around, looking out at different places until the women were all ordered to collect on the port side. Father and I said good-bye to mother at the top of the stairs on 'A' deck. She and the maid went right out on 'A' deck on the port side and we went to the starboard side. As at this time we had no idea the boat would sink, we walked around 'A' deck and then went to 'B' deck. Then we thought we would go back to see if mother had gotten off safely, and went to the port side of 'A' deck. We met the chief steward of the main dining salon and he told us that mother had not yet taken a boat, and he took us to her. Father and mother went ahead and I followed. They went down to 'B' deck, and a crowd got in front of me and I was not able to catch them, and lost sight of them. As soon as I could get through the crowd I tried to find them on 'B' deck, but without success. That is the last time I saw my father. This was about one-half an hour before the boat sank. I then went to the starboard side, thinking that father and mother must have gotten off in a boat. All of this time I was with a fellow named Milton C. Long, of New York, whom I had just met that evening.

"On the starboard side the boats were getting away quickly. Some boats were already off in a distance. We thought of getting into one of the boats, the last boat to go was on the forward part of the starboard side, but there seemed to be such a crowd around I thought it unwise to make any attempt to get into it. Long and I stood by the davits of one of the boats that had left. I did not notice anybody that I knew, except Mr. Lindley, whom I had also just met that evening. I lost sight of him in a few minutes. Long and I then stood by the rail just a little aft of the captain's bridge.

"The list to the port had been growing greater all the time. About this time the people began jumping from the stern. I thought of jumping myself, but was afraid of being stunned on hitting the water. Three times I made up my mind to jump out and slide down the davit ropes and try to make the boats that were lying off from the ship, but each time Long got hold of me and told me to wait awhile. He then sat down and I stood up waiting to see what would happen. Even then we thought the Titanic might possibly stay afloat.

"I got a sight on a rope between the davits and a star and noticed that she was gradually sinking. About this time she straightened up on an even keel and started to go down fairly fast at an angle of about thirty degrees. As she started to sink we left the davits and went back and stood by the rail about even with the second funnel. Long and myself said good-bye to each other and jumped up on the rail. He put his legs over and held on a minute and asked me if I was coming. I told him I would be with him in a minute. He did not jump clear, but slid down the side of the ship. I never saw him again. About five seconds after he jumped I jumped out, feet first. I was clear of the ship, went down, and as I came up I was pushed away from the ship by some force. I came up facing the ship and one of the funnels seemed to be lifted off and fell towards me about fifteen yards away with a mass of sparks and steam coming out of it. I saw the ship in a sort of a red glare, and it seemed to me that she broke in two just in front of the third funnel. At this time I was sucked down, and as I came up I was pushed out again and twisted around by a large wave, com-

ing up in the midst of a great deal of small wreckage. As I pushed it from around my head my hand touched the cork fender of an overturned life boat. I looked up and saw some men on the top and asked them to give me a hand. One of them, who was a stoker, helped me up. In a short time the bottom was covered with about 25 or 30 men. When I got on this I was facing the ship. The stern then seemed to rise in the air and stopped at about an angle of 60 degrees. It seemed to hold there for a time and then with a hissing sound it shot right down out of sight with people jumping from the stern. The stern either pivoted around towards our boat, or we were sucked toward it, and as we only had one oar we could not keep away. There did not seem to be very much suction and most of us managed to stay on the bottom of our boat.

"We were then right in the midst of fairly large wreckage, with people swimming all around us. The sea was very calm and we kept the boat pretty steady, but every now and then a wave would wash over it.

"The assistant wireless operator was right next to me, holding on to me and kneeling in the water. We all sang a hymn and said the Lord's prayer, and then waited for dawn to come. As often as we saw the other boats in the distance we would yell 'Ship Ahoy!' but they could not distinguish our cries from any of the others so we all gave it up thinking it useless. It was very cold and none of us were able to move around to keep warm, the water washing over her almost all the time.

"Towards dawn the wind sprang up, roughening up the water and making it difficult to keep the boat balanced. The wireless man raised our hopes a great deal by telling us that the Carpathia would be up in about three hours. About three-thirty or four o'clock some men on our boat on the bow, sighted her mast lights. I could not see them as I was sitting down with a man kneeling on my leg. He finally got up and I stood up.

"We had the second officer, Mr. Lightoller, on board. He had an officer's whistle and whistled for the boats in the distance to come up and take us off. It took about an hour and a half for the boats to draw near. Two boats came up. The first took half and the other took the balance including myself. We had great difficulty about this time in balancing the boat as the men would lean too far, but we were all taken aboard the already crowded boats and in about half or three quarters of an hour later we were picked up by the Carpathia.

"I have noticed second officer Lightoller's statement that J. B. Thayer was on our overturned boat, which would give the impression that it was father, when he really meant it was I, as he only learned my name in a subsequent conversation on the Carpathia and did not know I was 'Junior.'"

J. B. Thayer.

Chas. M. Hays.

C. M. Hays.

Chas. M. Hays was born on May 16, 1856, at Rock Island, Ill., and began railway work in November, 1873, as a clerk in the passenger department of the Atlantic & Pacific at St. Louis, Mo., and was later clerk in the auditor's and the general superintendent's offices of the same road. In 1887 he was appointed secretary to the general manager of the Missouri Pacific, and from 1884 to 1886 he was secretary to the general manager of the Wabash, St. Louis & Pacific, and then for one year was assistant general manager of the same road. In 1887 he was appointed general manager of the Wabash Western, and later of the consolidated Wabash System, becoming vice-president and general manager of the Wabash in 1894, remaining in that position until December, 1895. During that period he was a director of the Chicago & Western Indiana, the Belt Railway of Chicago, the Detroit Union Railroad & Station Company, the Hannibal Union Station Company, the Keokuk Union Station Company, the Kansas City Union Station Company, and the Terminal Road Association of St. Louis, of which latter company he was also chairman of the executive committee. He represented the Wabash in the Western Traffic Association, in the Central Traffic Association and in the Joint Traffic Association. He became general manager of the Grand Trunk on January 1, 1896, and left that company in January, 1901, to become president of the Southern Pacific Company. When this property changed hands he resigned and returned, in 1902, to the service of the Grand Trunk, as second vice-president and general manager. He was elected president of the Grand Trunk in October, 1909.

John B. Thayer.

John B. Thayer was born in Philadelphia, April 21st, 1862. After leaving the University of Pennsylvania, in 1881 he entered the service of The Pennsylvania Railroad as clerk in the Empire Line office, in which position he served for about eighteen months, when he was transferred to the general freight department, serving two years in the bureau of claims, and eighteen months in the rate department.

Upon the reorganization of the freight department, with

J. S. Wilson as general freight traffic agent, Mr. Thayer was appointed chief clerk, which position he held for three years, when he was appointed freight solicitor, United States Railroads of New Jersey Division.

In February, 1889, Mr. Thayer left the service of the company to engage in private business. He returned to the Company on May 1st, 1892, as division freight agent of the Northwestern Central Railway, with headquarters at Baltimore. On December 1st, 1894, he was promoted to the position of assistant general freight agent, with headquarters at Philadelphia; on March 10th, 1897, general freight agent in charge of through traffic, and on May 1st, 1899, general freight agent of the company, and also of the Northern Central Railway, Philadelphia, Wilmington and Baltimore Railroad, and West Jersey and Seashore Railroads.

One June 1st, 1903, Mr. Thayer was made fifth vice-president in charge of traffic. On October 10th, 1905, upon a change in the organization of the company, he became fourth vice-president, on March 24th, 1909, he was advanced to third vice-president, and on March 3, 1911 he was made second vice-president.

Mr. Thayer was a director of the Long Island Railroad Co. and various subsidiary companies.

ARMORED BOX CAR.

The rolling stock officials of Mexican railways have found it necessary to fulfil unusual requirements in car service on account of present political difficulties in that republic.

A car fitted up for military use by the Mexican Government is one of the latest innovations. It is made from an ordinary box car, the inside of which is lined with steel armor plate.

Three of the end holes are for two machine guns and one rapid fire gun. There are also eight windows at the top of the sides, which are used for ventilation when the car is not under fire. They are protected by steel shutters, which are slid over them when the car is in the danger zone. Ladders are placed at both side doors, so arranged that they can be readily swung down as soon as the door is opened, or lifted up into the car after it has been loaded. The ceiling is lined with metal, which provides protection from any attack from vantage points above the car. Although this car would not be a protection against shells, it is of decided advantage where only musketry fire is concerned. The outside of the car is painted with the checkered effect to hide the location of the port holes.

ELECTRIFICATION OF MELBOURNE RAILWAYS.

The latest large city of the world that has decided upon electrifying its suburban lines is Melbourne. The government is about to proceed with work on 200 miles of line, after deputing a commissioner to examine and report on the principal systems in both Europe and America. Though the density of population in Melbourne is not great, being only 2,000 per square mile as compared with 9,600 per square mile in greater London, the city is a very large one, holding some 40 per cent of the total population of Victoria, whereas, London holds only 20 per cent of the population of England. Its tramway system is a cable line and thus has not proved a serious rival to its railways so far, the railways carrying about one-half of the total suburban traffic. It is expected, however, that electrification will attract another 10 per cent of traffic, and as it already pays handsomely the cost of electrification will soon be recouped. Tenders are at present being invited on both the alternating and direct-current systems and it is believed the form of coach used on the Brighton railway will be adopted and that the power station will be run by steam turbines.—Indian Engineering.

If you see a tall fellow ahead of a crowd,
A leader of men, marching fearless and proud,
And you know of a tale whose mere telling aloud
Would cause his proud head to in anguish be bowed—
It's a pretty good plan to forget it.

If you know of a skeleton hidden away
In a closet and guarded and kept from the day
In the dark, and whose showing, whose sudden display,
Would cause grief and sorrow and lifelong dismay,
It's a pretty good plan to forget it.

If you know of a thing that will darken the joy
Of a man or a woman, a girl or a boy,
That will wipe out a smile or the least way annoy
A fellow, or cause any gladness to cloy—
It's a pretty good plan to forget it.

—*South African Railway Magazine.*

TASMANIAN RAILWAYS.

The Tasmanian Government railways now comprise 470¼ miles, a gain of only about 8 miles within the last five years. The total cost of construction and equipment of the lines open on June 30, 1911, was $19,827,178, representing a cost of $42,160 per mile. No information is given in Government reports as to the precise cost of various supplies and equipment purchased, and when bids are accepted, information concerning prices is not disclosed. Individuals or firms desiring to sell material there can not expect to find out what prices the Tasmanian Government might be willing to pay, but must state the prices at which they may be willing to sell. In the case of steel rails, it is understood that the average price paid has been about $50 per ton landed in Tasmania. The only details concerning supplies purchased for the Tasmanian Government railways for 1910-1911 appear in the latest report of the Government railways as follows:

Fuel: Native coal, 17,265 tons; Newcastle coal, 9,763 tons; charcoal, 2 tons 8 hundredweight; coke, 400 loads; firewood, 2,777 tons	$117,584
Oils: Axle, 4,915 gallons; bearing, 1,792 gallons; castor 3,840 gallons; colza, 2,299 gallons; cylinder, 1,697 gallons; linseed, (raw), 508 gallons; linseed (boiled) 112 gallons; red machinery, 260 gallons; kerosene, 10,598 gallons; sundry, 620 gallons	19,424
Tallow, etc.: Tallow, 29 hundredweight; grease, 7 hundredweight	257
Paints and varnish	4,311
Packing: Square and round, 435 pounds; asbestos, 77 pounds; hemp, 16 pounds; I. R. insertion, 42 pounds; cotton waste, 15 pounds	2,287
Stationery, etc.	10,166
Timber	37,759
Iron	30,206
Tools	4,608
Electrical Material	2,150
Sundries	28,405
Rails and Fastenings	41,058
Total	$298,215

The rolling stock report for 1911 is as follows:

Description	New	Repaired
Locomotive	..	52
Passenger Cars	..	975
Freight Cars	36	2,255

By placing set screws in the valve stem slides of locomotives, blocking of the valves is made unnecessary when the engine is hauled dead. In case of engine failure, the engineer simply screws down the set screws and locks the valve. He can then block the cross heads in the usual way.

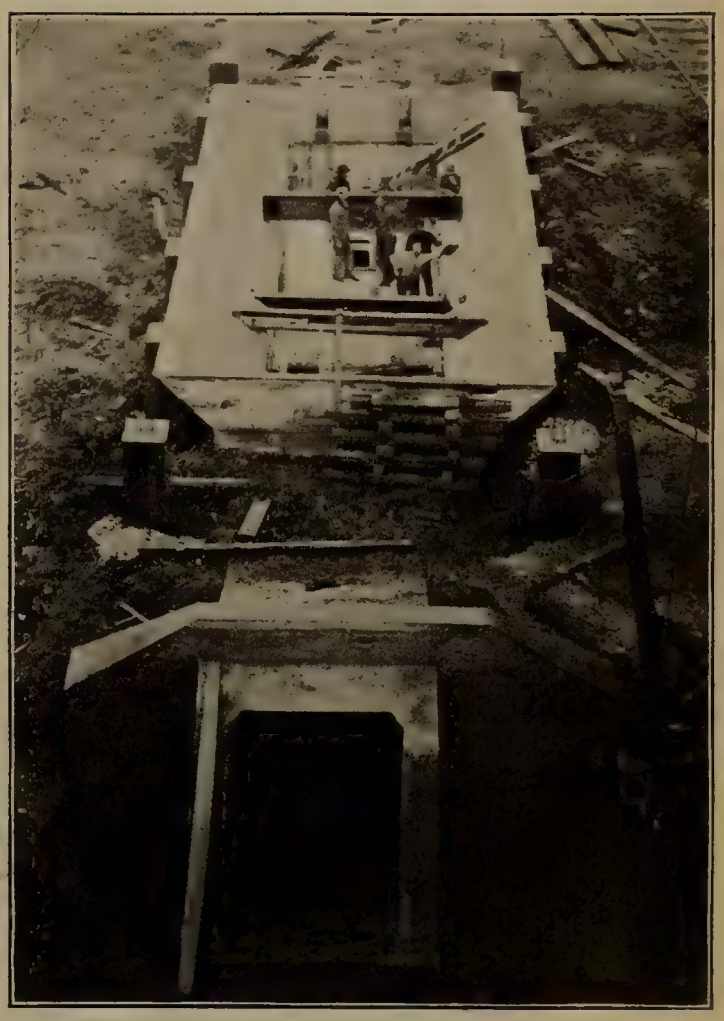
Sand-Drying Plant, United Railways of St. Louis*

By C. L. Hawkins.

The United Railways Company recently completed the construction of a new plant for drying the sand used in the boxes on the cars. The amount of sand used depends upon the condition of the rail and it is absolutely necessary that the sand be dry and free from gravel in order to flow freely from the boxes. The amount of sand used per month varies from about 300 cu. yd. during the dry summer months to 1,300 cu. yd. during the winter months, the total for the year being about 6,000 cu. yd. The sand used is ordinary Mississippi River bar sand and contains considerable gravel and from 3½ per cent to 5 per cent of moisture when it arrives at the drying plant.

The location selected was on a tract of land at the western city limits, where it was also proposed to locate a new sand pit. Two apron conveyors carry it from the openings in the bottom of the pit and deliver a uniform flow of sand to a belt conveyor leading to the rotary dryer. This dryer consists of a revolving steel cylinder 4 ft. in diameter and 20 ft. long, supported above a hand-fired furnace buring slack bituminous coal. The center line of this cylinder is set on a grade of about ½ in. per ft. The sand is received at the upper end and is tossed about by six curved lifting blades while an exhaust fan draws the hot gases around the cylinder and then into it through openings in the periphery, thus bringing the hot gases in direct contact with the sand as it travels toward the lower or discharge end of the dryer. A bucket elevator conveys the dry sand to a revolving screen located on top of the reinforced concrete bin. From this

Completed Plant, Showing Elevated Dry Sand Bin and Gravel Bin.



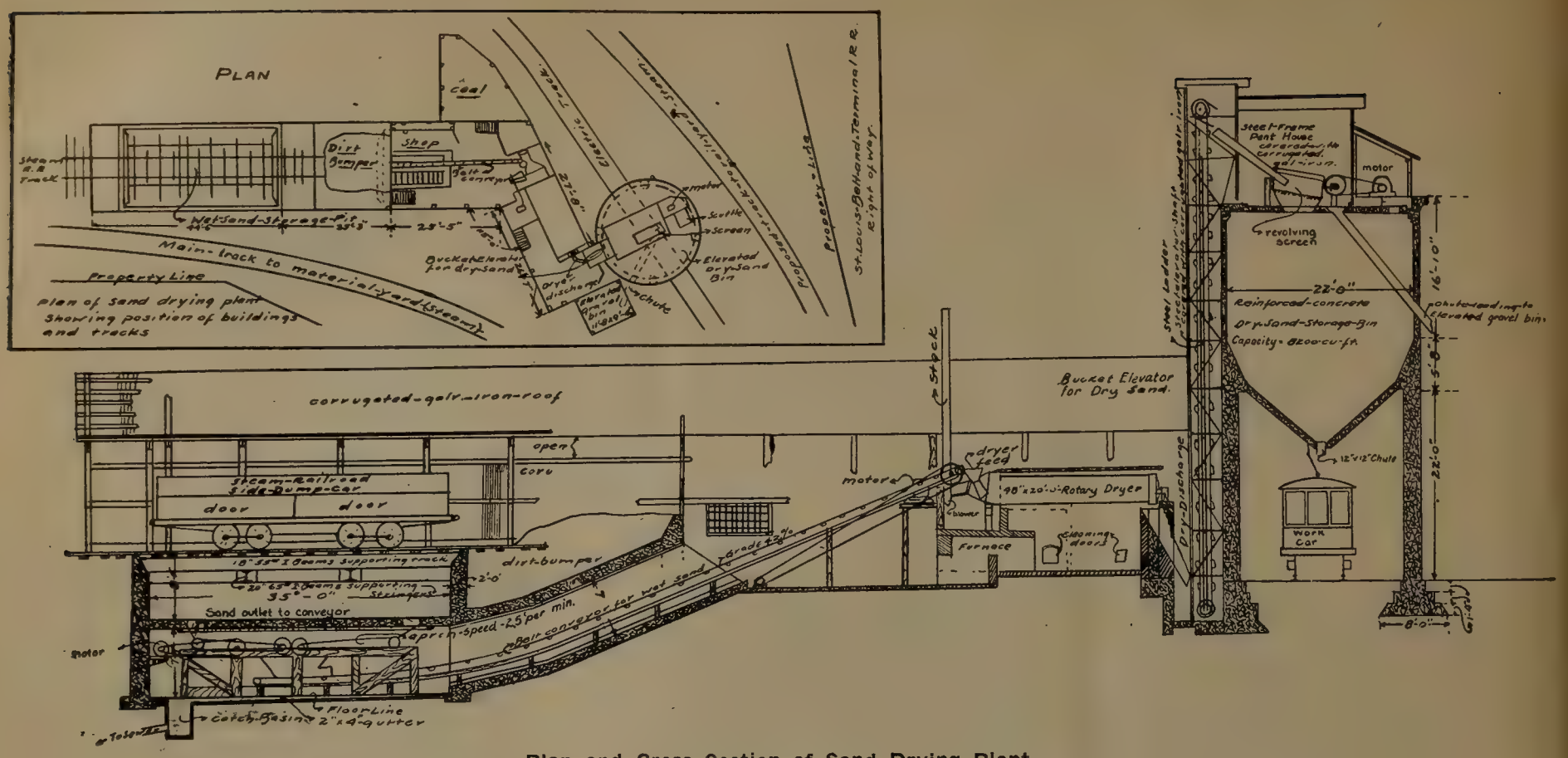
Wet Sand Pit and Tunnel for Conveyor Belt.

supply yard suitable for handling all of the material required by the track department. This yard is on the south side of the inner belt line tracks of the Terminal Railway Association and the switching charge per car is three dollars less than at the Park and Vandeventer yard, which is located on the St. Louis and San Francisco railway tracks. As it was necessary to do quite a large amount of grading before the entire lot could be shaped for tracks, the sand plant was placed at the north end where very little track work was necessary to put this plant in operation and where valuable storage space was not utilized.

The cross-section of the plant shows the course of the sand from the time it is dumped from the Union Sand Company's side-dump steam railway cars until it falls from the elevated bins into the work cars ready for the distributing bins. The wet sand is dumped directly into the wet screen the sand falls directly into the bin and the gravel passes through a chute leading to an elevated gravel bin.

The wet sand pit was designed to hold about 3,000 cu. ft., or about two days' supply; 1,500 ft. of this will slide into the openings with little or no shoveling. The conveying machinery below required a space about 10 ft. wide, so the pit was made the same width, with the sides sloped back at the top to catch the sand as it falls from the side-dump cars. The floor of the pit is 13 in. thick and is reinforced with ¾-in. square rods 6 in. apart. The walls of the pit are 2 ft. thick and are not reinforced. The sloping sides were reinforced with ½-in. square rods 12 in. apart, more for use in case of derailment of cars than for sand loads, as the sides are supported by a dirt backing. The four sides of the tunnel leading from the machinery room were made 15 in. thick and reinforced with ¾-in. square rods 9 in. on centers. The dirt bumper on top of this tunnel is at the foot of a 2 per cent grade, 1,200 ft. long, and on account of the damage that might result from careless switching, the tunnel was made considerably stronger than the dead or live loads required. For temperature reinforcement

*From a paper read before the Engineers' Club of St. Louis and published in the Journal of the Associated Engineering Societies.



Plan and Cross Section of Sand Drying Plant.

½-in. square bars were used in the reinforced parts of the pit and tunnel.

In the design of the dry sand bin holding 8,200 cu. ft., fluid pressure at 100 lb. per cu. ft. was used in computing the side and bottom reinforcement. The circular beam between the posts at the bottom of the bin was designed to hold four tenths of the total sand load, but the conical bottom was designed for full load. The vertical side walls of the bin are 7 in. thick, and the ring reinforcement increases from ⅜-in. square bars 12 in. on centers at the top to ¾-in. square bars 6½ in. on centers at the bottom. Vertical temperature rods are ½-in. square bars 18 in. apart. The conical bottom is 9 in. thick with ring reinforcement varying from ¾-in. square bars 6½ in. apart to ⅝-in. bars 9 in. apart. The radial reinforcement in the bottom consists of one hundred and twenty ¾-in. square bars, thirty of which run to the opening at the bottom, while the others stop at the ¼, ½ and ¾ points. The circular beam is re-

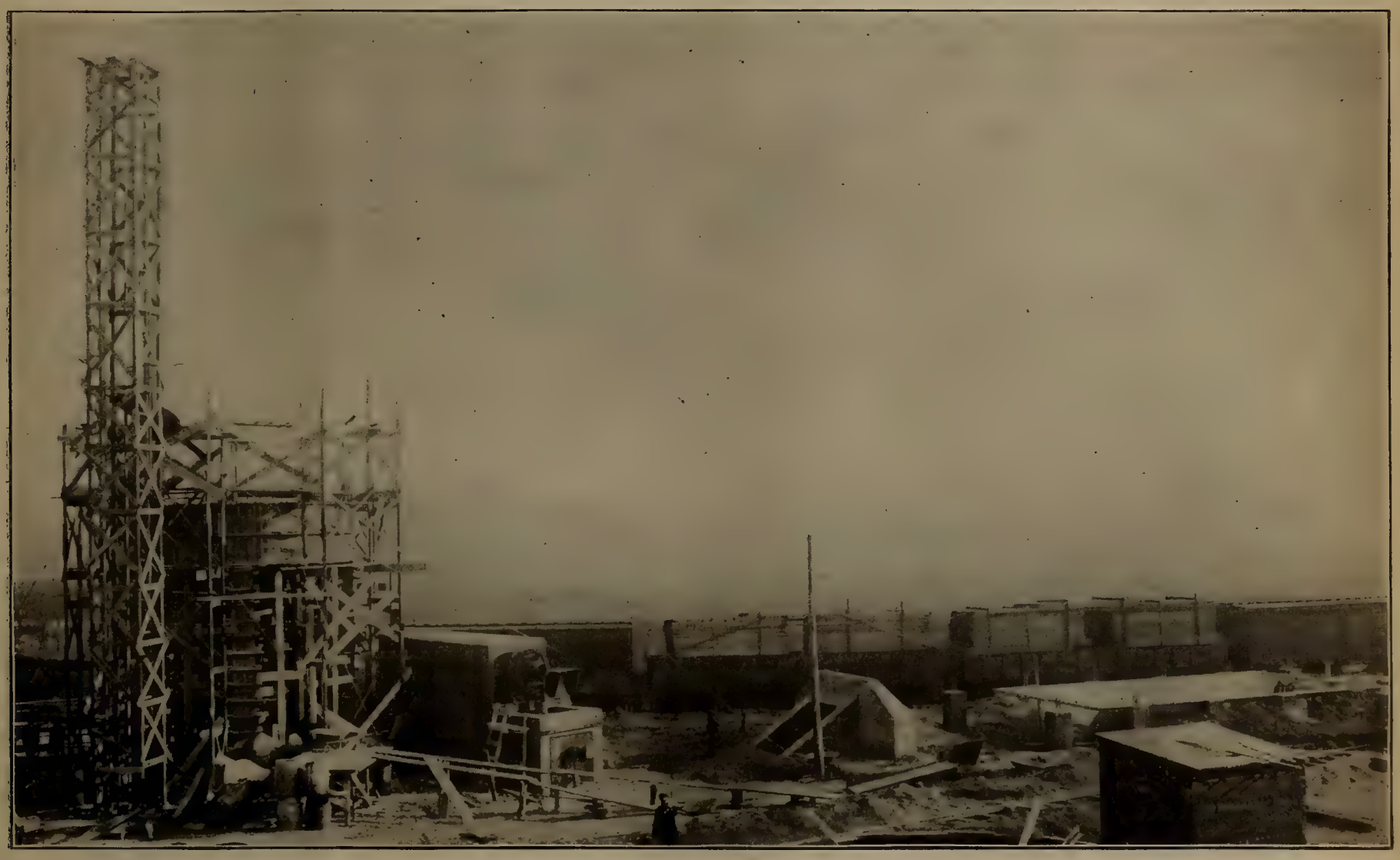
Wet Sand Conveyor Belt and Front of Rotary Dryer and Furnace.

inforced with eleven 1-in. square bars, seven of which are at the bottom. The roof was made 9 in. thick with reinforcement running both ways. The columns are 24 in. thick with ¼-in. square hoops 12 in. apart and eight ¾-in. square vertical bars; the opposite center bars are tied together with No. 12 wire and all vertical bars are imbedded about 40 diameters in the circular beam and also in the ring foundation.

All of the construction work was done by the building and mechanical departments of the company. Machine mixed gravel concrete of 1:2:4 mix was used where reinforcement was required and 1:3:5 for the plain concrete. The water for the concrete was supplied by a track sprinkling car equipped with an air compressor for lifting the water to the mixer.

the Link Belt Company. The two apron conveyors consist of 3/16-in. steel overlapping corrugated pans 9-in. pitch and 18 in. wide attached to a steel bar link chain supported on rollers. The 14-in. conveying belt is made of 4-ply rubber belting with 1/16-in. rubber covering and carries the sand up a 42 per cent grade very satisfactorily. The bucket elevator consists of 7-in. by 4½-in. by 4-in. malleable buckets 12 in. apart on a 4-ply rubber belt. The screen is 36 in. in diameter and 6 ft. long, with 3/16-in. openings between the wires in the covering. The conveyors, etc., are operated by four motors.

The cost of the buildings and machinery for this plant was approximately $14,000. The plant is operated by two or three men (from one of the car houses), depending on the condition of the sand; these men unload the cars, fire the



Dry Sand Storage Bin, Rotary Dryer During Construction.

In the construction of the dry-sand bin the ring foundation was poured at one time, then the posts up to about the ¾ point. The inside and outside forms for the lower part of the circular bin, up to the 7-in. wall, were built on the ground in sections. After the entire lower or inside form had been placed, all of the rods, except those in the roof and the ring reinforcement in the 7-in. wall, were placed and securely fastened with wires or with nails and small concrete blocks. The inside form was then placed and anchored to prevent floating. After this section was concreted the side walls were poured in three sections, moving the same forms up about four feet each time. The roof and the last of these sections were poured at one time.

The gravel bin was built of wood, as was also the frame of the building surrounding the dryer and the wet-sand pit. The frame of the elevator tower and the screen house on top of the dry-sand bin were made of 3-in. by 3-in. by ⅜-in. angles. All of these buildings were covered with corrugated galvanized iron.

The conveying and screening machinery was furnished by

furnace, watch the moving parts and keep them properly oiled, and keep the plant clean and in good order. On one of the first tests before the machinery speeds were properly adjusted the following results were obtained:

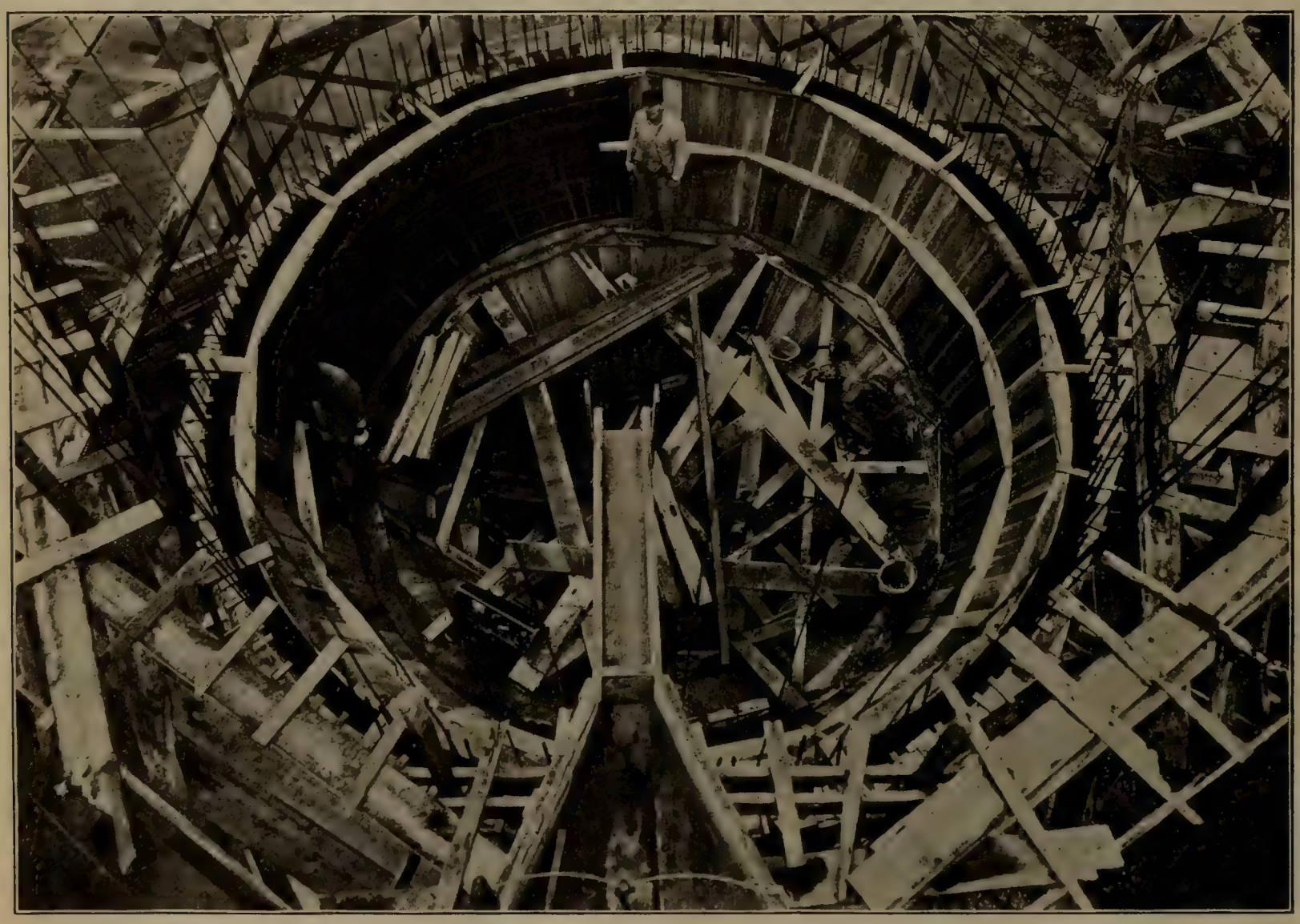
Moisture, 4 per cent.	
Length of tests, 18.8 hr.	
Cubic feet of sand dried, 2,650.	
Pounds of coal used, 4,340.	
Power used, 240 kw. hr.	
Weight of water evaporated per pound of coal, 2.45 lb.	
Tons of sand dried per hour, 7.05.	
Tons of sand dried per ton of coal, 61.	
Cost of operating machin'y per cu. ft. sand,	$0.0044
Cost of power per cu. ft. of sand,	0.0009
Cost of coal per cu. ft. of sand,	0.0016
Sand and freight per cu. ft. of sand,	0.0172
Interest, depreciation and taxes (12 per cent),	0.0104
Total,	$0.0345

After this test the dryer speed was increased and a new

test made. The sand at this time contained 3¼ per cent of moisture.

The length of test, 13.5 hr.	
Cubic feet of sand dried, 3,200.	
Pounds of coal used, 4,400.	
Power used, 300 kw. hr.	
Weight of water evaporated per pound of coal, 2.55 lb.	
Tons of sand dried per hour, 11.84.	
Tons of sand dried per ton of coal, 73.	
Cost of labor per cu. ft. of sand,	$0.0026
Cost of coal per cu. ft. of sand,	0.0012
Cost of power per cu. ft. of sand,	0.0009
Cost of sand and freight per cu. ft. of sand,	0.0172
Interest, depreciation and taxes (12 per cent),	0.0104
Total,	$0.0323

The total cost of drying 6,000 cu. yd. of sand by the stove method, including the cost of maintenance, etc., of the necessary dry-sand storage bin, would amount to about $7,290 per year. The total cost of drying at the new plant, figured at $0.0323 per cu. ft., is $5,232.60, a saving of $1,957.40 per year, $510 of which is due to the saving of $3 per car for switching charges.



Forms and Reinforcement in Conical Bottom of Dry Sand Storage Bin.

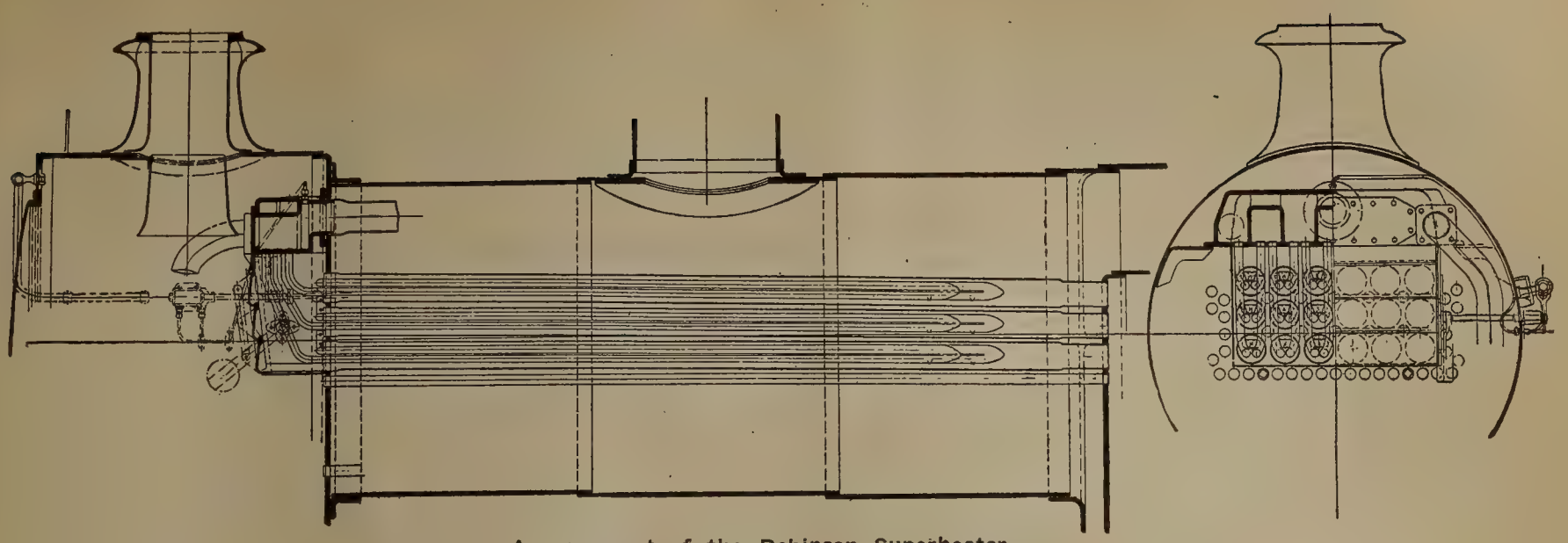
THE "ROBINSON" SUPERHEATER.

The Great Central Ry. is now using the "Robinson" smoke tube superheater, which is the invention of the chief mechanical engineer, Mr. J. G. Robinson, M. I. C. E., M. I. M. E. In this design the elimination of maintenance troubles has received special attention, as well as the simplification of the methods of connection between steam pipes and the superheater header. The superheater is composed of a number of cold-drawn Siemens-Martin mild steel pipes and a cast steel header or steam collector into which the ends of the superheating pipes are expanded. In applying this superheater to a locomotive-type boiler the steel header or collector is connected by a flange to the main saturated steam pipe leading from the dome immediately above and clear of the fine tubes in the smokebox tube plate. This header is divided into separate compartments, several of which receive and distribute the saturated steam pipe to the superheating pipes, and the remainder receive the superheated steam from the superheating pipes and distribute it to the pipes leading to the cylinders.

The superheated and saturated steam compartments are covered by a plate made steam tight and secured by studs and nuts. This is removable to permit of the header being examined internally and for the introduction of the tube expander into the ends of the superheating pipes for expanding them into holes in the bottom of the header.

The bottom of the header or collector, which forms the tube plate into which the ends of the superheating pipes are expanded, lies parallel with and above the center line of the top row of smoke or flue tubes. A number of the smoke or flue tubes are of large diameter to receive the superheating pipes; these pipes leave the header in vertical planes until opposite the large flue tubes, when they are bent at right angles and extended into the smoke or flue tubes. Each superheating pipe or element consists of four lengths of pipe extending nearly the whole length of the large smokebox or flue tubes, the ends of each length of pipe being connected by "Howell's" improved torpedo ends.

In the "Robinson" superheater, it will be noticed there are no flanged or other special joints for connecting the elements or superheating pipes to the header. The degree of superheat attainable by this superheater is claimed to be



Arrangement of the Robinson Superheater.

equal to that obtained by any other type of locomotive superheater.

Amongst the advantages claimed for the "Robinson" superheater are the following: It is of simple and substantial design and free from a multiplicity of parts, considerably reducing the cost of installation and maintenance. The interior of the header compartments are easily accessible for examination and renewal of the superheating pipes; this design also ensures sound castings. The superheater tubes can be readily disconnected from the header and re-expanded into it without damage.

The advantages of highly superheated steam for locomotives are now generally recognized, and the following figures obtained from the trials of a six-coupled goods engine fitted with this superheater, as compared with a non-superheater engine, will be of interest.

Taking the vaporization of water at 9½ lb. per pound of coal an economy of 14¼ gallons of water per mile was shown. Taking a year's running to be 35,000 miles this would show an economy of 234 tons of coal and 498,700 gallons of water with the superheated engine. There is also a reduction in boiler repairs, as well as an increased haulage capacity.

Although the "Robinson" superheater has only recently been put on the market by the Locomotive Superheater Co., Ltd., of Palace Chambers, Bridge St., Westminster, nearly 200 engines have been equipped or are on order for fitting with this device. It is to be fitted by the G. N., N. E., S. E. & C. and other lines.—The Locomotive (England).

Mr. John C. Frit, formerly assistant to the operating manager of the American Bridge Co., in the western division, has been elected president of the Joliet Bridge & Iron Co. He succeeds Mr. Robert C. Morrison, who died last November.

The stockholders of the Kelly-Reamer Co., at their annual meeting April 20th, elected Wm. E. Kelly, W. A. Calhoon, H. J. Maxwell, O. H. P. Davis, E. B. Sessup, Geo. Bauer and Thos. A. Torrance directors, who elected the following officers: Wm. E. Kelly, president and general manager; W. A. Calhoon, vice-president; H. J. Maxwell, secretary, and O. H. P. Davis, treasurer.

Dangers of Shortage of Railway Facilities and Possible Preventives

By Chas. L. Sullivan.

The dangers of shortage of railway facilities are most apparent to those most concerned in providing adequate facilities for the safe and economical transportation of goods and people, and they are saying, "Show us how to provide what is needed."

In the opinion of the writer of this the answer is found, not in following one course, the one course of issuing new bales of securities, but in a comprehensive course that includes the issuing of additional securities plus the discontinuance of practices that lead to losses, plus the adoption of plans of financing and operation that will increase gross and net earnings. And some suggestions are made herein of plans that are thought to be of favorable relation to the above conditions.

The texts for this essay are found in a declaration from the Interstate Commerce Commission, 1908, to-wit:

"That the inadequacy of transportation facilities is a little less than alarming," and in the statement of results of an inquiry made by the Railway Business Association and published in the bulletin of the association, also to-wit:.

1. Locomotive, car and track capacity have increased since 1907 at a rate immensely less than what will be necessary to meet an increase in traffic approximately at the rate of growth shown in the immediate past. Current net car surplus is at so narrow a margin that a very small increase per cent, in the traffic offered would produce a net car shortage.

2. Equipment requirements to carry traffic conservatively estimated for the five years ending 1915, will cost the railways a sum enormously in excess of their probable resources from earnings.

3. It will require the sale of new securities to an amount many hundred millions greater per annum than in the immediate past to obtain the necessary sums not available from income.

4. In order to attract purchasers and to justify incurring the obligation to pay a return on such new capital, the railways must be reasonably assured that freight rates will not be further reduced.

5. The public has now taken control of the rates. With the public the decision rests whether the rates shall or shall not be adequate to enable the railways to meet the necessities of the shippers. Failure to provide the facilities which will be needed to carry the traffic must be laid at the door of the public and the public must provide the means for providing the facilities.

That railway officials of single mind to the operating of railroads for the best interest of all concerned are trying to improve transportation facilities and at the same time reduce cost of operations, no generous minded man acquainted with the facts will deny. But the means are not at hand to do both of these things, or even to do one of them adequately; it requires means to reduce costs of operation and to increase facilities.

Railroad wreckers have been nearly all squelched. Hold-up politicians are rapidly losing their power, private car grafting is nearly at its end, rebating has had its wind knocked out, inequitable Federal and State laws have been recognized as poor means for bringing benefits to the people; equipment trust syndicates and banking syndicates still demand, and get, their pound of flesh in the form of 5 per cent to 7 per cent for marketing bonds, stocks and notes of railroads at liberal commissions and discounts.

The Big Thing, among a multitude of other things, that ails railroads today is the high rates of interest paid for borrowed money, or money secured by the sale of bonds and notes. The Federal Government can market bonds at any time and in any amounts at as low as 2½ per cent. The people through the Federal Government should undertake and complete the job of bringing about conditions that will establish equally as good credit for the railroads, although not necessarily establish as low rates of interest as 2½ or even 3 per cent.

Not even the conservation of natural resources, the regulating of business combinations, the reform of the currency and banking laws, the country's foreign policy, or the settling of the tariff question are of greater importance than the rescue of the railroads from their present demoralization, their restriction to the legitimate functions of selling transportation pure and simple, and the placing within their reach the means at low cost for much needed betterments and extensions. The country's internal development and its growth among nations are dependent more upon the railroads as means to these ends than upon any other one media in political, business or social life. Railroads might be considered as the nation's largest and most valuable resources.

Our railroads were the most important means that opened and developed the country and this credit is due them regardless of errors, private exploitations and other undesirable things inevitably accompanying the rapid building of a nation or of a big industry.

The Panama canal is of Nation and World importance and our country was the one to build and control it, but the railroads immediately within our borders are nearer to the interests of our people than is the canal.

That the people are determined that our railroads shall exist and operate for the interest of the whole people and not alone for a small minority bent on building large private fortunes. is evidenced in the increasing volume of the voice of the people expressed through irrepressible agitation for rate regulation laws, and in a not insignificant nor lessening demand for Government ownership of railroads, and in the growing utterances in favor of Socialism.

To ward off the calamity of extreme Socialism it is necessary to increase the scope of Federal Paternalism. But Government ownership of railroads is not necessary in order to secure to the people the rights belonging to them resident in their ownership of the power and right of granting privileges for operating, and making reasonable profits only out of public utilities. The people own the rights in public utilities as they own the air, and light and the land and the water, and as they should own the natural resources upon which man is depending for maintaining life. Failure to secure these rights from existing political and social order of things will drive the people to force a change and at present a change means Socialism which means in part, Government ownership of railroads.

In the Railway Business Association bulletin, referred to above, it is stated: "the public has now taken control of the rates, and in time equitable rates will be established."

Up until recently our railroads were financed and manipulated almost to the exclusion of the rights of labor and the public generally; the only thing that was recognized as having any right or interest was the dollar.

In the long fight between the dollar oligarchy on one side and the general public and labor on the other side, the railroads were bound to lose. The people look to the Federal Government to protect them as the supreme interest for which governments are organized. The people have the last word, and if government as exercised does not properly care for the people then Congress and the courts will be changed. At present the people are not very well satisfied.

The thing of greatest importance to the country at the present time, and the one needing immediate attention is TRANSPORTATION. There is danger in delay. The country is tired of its greatest natural resources being used by individuals, syndicates, pools, trust companies, insurance companies and banks to build in a few years large fortunes for a small ring of men that control the means for such use.

One of the ways for warding off either the necessity or the demand for Government ownership of railways is for the Federal Government to provide a way for supplying railways with needed funds for extensions and adequate facilities and tor a management that will institute a uniform rate of operating as contrasted with the present spasmodic rate, and at the same time make railroad stocks and bonds staple and sure earners of reasonable dividends and interest. This would of necessity eliminate stock watering and materially reduce gambling in railroad securities called by courtesy by another name. It has been frequently said that the financial interests in control of our railroads can and do arbitrarily make or retard prosperity in our country, and that this power has been used, and is now being used to mould political and social conditions favorable to the retention of this power in the hands of what is either rightly or wrongly called the money trust as distinguished from the general public.

The Railway Business Association bulletin states, "equipment requirements for five years ending 1915 will cost the railroads a sum enormously in excess of their probable resources and earnings." And other statements in the bulletin show railroads in such conditions and working under such restrictions as to make it practically impossible for them to add adequate facilities, to make extensions, etc., unless material changes in the conditions and restrictions shall be made. Present methods followed by the railways in obtaining funds is to sell stocks, bonds and short time notes to banks, syndicates, trust companies, etc., at rates of interest averaging probably 5½ per cent for all railroad companies and covering the several kinds of securities sold. And these securities seldom net par to the railroads. There are exceptions when money costs railways 3 per cent, 3½ per cent, 4 per cent and there are many loans at 7 per cent in the form of equipment notes, special bonds, etc.

No mercantile industry could pay dividends or make liberal additions to plants for increased facilities, by earnings as low as are represented in the receipts by railroads at present freight and passenger rates, rates of taxation, legal expenses, etc., should said earnings be burdened to pay 4 to 7 per cent on securities far beyond the fair cash value of said industries and excluding a value for charter or franchises. The burden in the case of railroads is as much in the high interest rates as it is in the relative amount of securities drawing interest. The conditions would not be so bad should railroads receive

par or nearer par than they generally receive for the securities put out.

A saving of about 1 per cent in the average interest rate would be a sum equivalent to an increase in receipts from a fair increase in freight and passenger rates, and would probably take care of the increase in prices of materials, labor and taxes.

That I am not alone in thinking that railroad companies pay too high interest rates is proved by a quotation from the Railway Age Gazette of April 19, 1912, on page 877, in a first page editorial commenting on an address delivered by Mr. Delano before the convention of Commercial Associations of Michigan in a meeting at Detroit, April 17th; the comment being that railroads have been beset (among other things) "by increases in the rate of interest."

The public is not so much interested in securing high rates of interest as it is in securing protection to its capital, certainty of continuous income, and in stable business conditions. Loans to railroads are now made by those who loan to and those who control the roads, and being the same individuals the transaction is like loaning money to oneself and making an innocent party, the public, pay the interest.

The plan here suggested would provide a cheaper money market to which railroads could go and where they would receive a full dollar in cash for a full dollar of security paid out; it would creatc a source of money supply at any time when needed regardless of and in opposition to the too frequent artificial conditions prevailing in Wall Street and the humor of big money lenders. Under this plan the people would find railroad securities better things to put money into than even the Postal Banks. It is probably true that this plan would be opposed by the investors composing the present money market, whether such market is a money trust or a condition of financial operations based on custom and on the elements of demand and supply; demands for loans and supply of funds for making loans. But the public. as distinguished from professional money lenders, would supply more than the loss resulting from the withholding of loans by the "market." The people thus in time would own the roads.

A flood of funds from abroad would come over were our Federal Government back of a plan for financing our roads, and in a measure dictating major expenditures, establishing stability in rates, wages, taxes and other capital charges. And this immigration of foreign funds would strengthen our nation politically and lessen the chances of wars that would endanger the investments of the people of other nations.

A provision for confiscation of foreign investments in our railroads would be more effective than arbitration treaties.

The Federal Government should control the financing of railroads as it now controls rate making. Passenger and freight rates should be established that would allow a fair interest return on railroad securities and fair dividends, and these rates should remain in force for at least five years before being changed either up or down.

The central idea of the plan is that the Federal Government should create a fund by the direct sale of bonds, or by guaranteeing the interest on bonds to be sold by railroads under popular subscription. The fund to be provided to be one billion dollars ($1,000,000,000) the first year and five hundred million ($500,000,000) dollars each next succeeding year for four years. Either plan to be under a carefully matured congressional enactment and the fund to be available to or raised by railroads under the approval of the Interstate Commerce Commission both as to the amount and the purpose of the expenditure of same, the actual expenditures to be left to the railroads.

Those individuals, syndicates, pools, trust companies, insurance companies, and banks, that have heretofore enriched themselves by providing funds and credits at heavy expense to railroads at high interest rates and commissions, now refuse to as freely as heretofore advance funds to railroads because of the present check by public opinion to this method of rapid wealth getting and to the exclusion of the interests of the public.

Again, nondescript, indiscriminate and contradictory laws innumerable that have been passed by state legislatures composed largely of demagogue politicians, unwise honest men, and men of juvenile abilities and judgment, have, as a logical result, tied purse strings and checked confidence in the worthiness of railroad stock and bond investments; and the lack of worthiness and stability of Federal controlling laws have disturbed and deterred the investing public. Some folks with strong predilections for railroad monopolies have chosen to attempt to influence the public and legislative mind to the belief that the Panama Canal will hurt trans-continental railroads, and this unjustifiable stirring up of the public mind is another one of the deterrents to investments in fresh railroad securities.

This is not an attack upon railways, but it is an attack upon the prevailing system of financing many railways, which system, coupled with other bad conditions referred to herein, puts railway earnings under a tax so heavy in the aggregate as to amount to practical confiscation of the earnings.

Railways are probably not over-capitalized if we consider the cost of reproducing them at present prices; but they are overloaded with unnecessarily high interest charges on securities other than capital stock certificates.

If sufficient revenue cannot be secured from present tariff rates, and if Wall Street will not furnish funds except at its dictation as to volume, time of lending, interest rates, and dictate how funds shall be expended, and through what channels, and if therefor both the railroads and the public suffer then the Federal Government should provide a way whereby the roads could go direct to the public for funds, and then roads should be operated irrespective of the attitude of Wall Street.

If revenues under present rates are not sufficient to enable railroads to supply adequate facilities, to pay increased taxes, increased wages and other increased costs of operating, and as the established order of things, and the attitude of the public mind, will not permit of rate increases, then railroads must practice economies in new directions; (and a few of these directions is suggested herein) secure stability in rates, wages and taxes, and pay less for funds secured by issues of securities, and also, lower dividends must be expected and accepted until roads are enabled to increase net earnings as reward of increased facilities and reduced costs of operating.

There is an impossible condition of things facing railroads. There is an "unreasonable restraint" upon their conduct as public utilities. The removal of this restraint is within the constitutional prerogative of the people acting through the creation of its own will, i. e., the Federal Government. No self constitued oligarchy of a moneyed minority should be allowed to exploit the people's best possession, TRANSPORTATION. The people's rights are prior to the rights of the money power. It is not now so much that railroads need control as it is that money lending to railroads and money spending by railroads need control. Conditions should be established that would cause the people to feel as secure in investing in railroad securities as they would in depositing their money in national banks that are supervised by the Federal Government, and for the same reason.

In the past and at present the financing of railroads has been and is on the plan of when, how, and how much, at the dictation, whim or by the policy for effect upon the public and legislative mind, of the monied minority controlling the distribution of the controllable funds available in our country.

If it is accepted that the present stock capitalization of

our roads is not excessive, but only represents a fair cash value of the roads, if it is true that liberal dividends could be paid upon all outstanding stock, if transportation rates, taxes, wages, cost of equipment and supplies and interest rates were more stable and the present minimums and maximums not changed for a series of years, then, to enable roads to secure the considerable sums needed, and which admittedly cannot now be secured from earnings, it is not necessary nor advisable to increase capital stock issues on present railroad properties, but instead to secure loans on convertible bonds and short term notes depending upon the several conditions that would govern. As roads would be added to by increased trackage of parent roads, extensions, and the building of feeder lines, the convertible bonds and notes could be redeemed by issues of capital stock at par covering the new plants and thus balancing new stock issues with the new railroad plants.

Roads doing interstate business should be nationally chartered, state charters to be surrendered or their cancellation purchased, capital stock of interstate roads to be freed from state taxation, and in lieu of Federal direct taxation there should be an income tax by the payment of a small percentage of the dividends, and periodical reports from railroads should be made of the names of stockholders, the list to give the number of shares of stock owned by each person and the dividends paid and other information that would prevent dodging of the income tax and insure a full return in payment of said tax. In case of foreign holdings of United States railroad stocks there should be a straight tax instead of income tax.

As it is believed that the borrowing credit of all interstate trunk lines should be equally good, and it is believed that it would be, under the plan of financing here suggested, then roads should deposit their bonds at par at 3⅞ per cent with the Federal Government for the amount of funds needed and to be drawn from the funds provided by the sale of specific United States bonds at 3¾ per cent. The railway bonds for this transaction should be a lien exclusively upon the new trackage built, upon new terminals purchased, laid out and equipped, and upon new equipment or rolling stock, and the present outstanding bonds should be excluded from participation in the new values thus created. As old bonds would mature there would be no need of issuing new securities to take their places.

Eventually roads would have no securities out but stock certificates representing the real value of roads exclusive of the value of their charters; the charter values remaining an asset of the public.

Presumably present outstanding bonds would increase considerably in speculative market values, but this would not of course increase their interest rates or lay any additional burdens upon railroad earnings.

Should there be bonds maturing earlier than the time required for securing by the railroads of definite benefits from the improvements and increased earnings under the operation of this plan, then such bonds should be refunded at 3⅞ per cent (unless some of them should now be bearing less rates of interest), and the new bonds for refunding should be convertible bonds for short terms.

If some roads can sell 3½ per cent bonds why would it not be a good thing to establish a plan for financing, and safeguarding railroads so that all could sell at 3½ per cent or not to exceed 4 per cent bonds? A saving of 1 per cent in the average interest rate on the upwards of nine billions of railroad bonds now outstanding would mean a saving of 90 millions of dollars per year. This amount added to what might be saved in some such ways as are suggested below, and these added to the increases in earnings coming from adequate facilities would supply our roads with the funds that they need, but which they say they cannot now get.

All trunk line bonds should bear, and would be acceptable to the general public at the same interest rate under the plan here suggested. And it would not be necessary for roads to pool their earnings for common distribution in the form of dividends.

After 10 years, dividends on railroad stocks above 6 per cent should be devoted to still further increase the facilities of roads, or transportation rates should reduce automatically as net earnings applicable to dividends exceed a sum or sums equivalent to 6 per cent upon capital stock.

Upon maturity, or upon any interest date and notice, bonds deposited by railroads with the Federal Government for loans under this plan, are to be exchanged for stock certificates, and these to be used by the Federal Government in exchange for the bonds issued under this plan. This would be the process for making the public the stockholding owners of our roads.

It is stated that the ownership of 55 per cent of our roads is in the hands of about 23 men who represent the not many more men who collectively have provided the funds for securing this 55 per cent control, and of course this 55 per cent control coerces the remaining 45 per cent. And this control by the monied minority is not a good substitute for government ownership of our roads or for socialism. And unless the present order of things in the ownership and operation of our roads is changed to a larger public ownership of our roads and their operation for the rightful benefit of the public, then government ownership or socialism or both will come with a certainty.

To further emphasize the statement that roads are handicapped by high interest rates it is only necessary to note a few modern instances of loans secured by the issue of securities. One road has just sold 10 million dollars worth of 7 per cent bonds, the annual interest charge is 700 thousand dollars; at 4 per cent the interest charge would be 400 thousand dollars, showing a saving of 300 thousand dollars per year.

Another road has sold 19 million 500 thousand dollars of 4½ per cent gold notes at an annual charge of $877,500. If sold at 3⅞ per cent a saving of $121,875 would be made. The St. Paul road has sold or is about to sell 35 million convertible bonds at 4½ per cent, and the interest charge is one million five hundred and seventy-five thousand dollars. Could these bonds be sold direct to the public undoubtedly a rate of 3⅞ per cent would have been acceptable and there would have been a saving of $218,750. That the average interest rates paid by railroads on issues of bonds is higher than a rigid conservation of earnings calls for can be ascertained by a survey of the tables of bonds outstanding as given in the railway manuals. A fairly selected list of 70 bond issues showing bonds outstanding, annual charges and interest rates, gives an average interest rate of about 4⅝ per cent, the range being a few issues at 3 per cent, not very many more at 3½ per cent, and a fair lot at 4 per cent and others at 5 per cent, 6 per cent and 7 per cent. Some bonds bear 8 per cent and one lot carries 10 per cent. Of a total list of 1,927 bond issues the average interest rate shows above 4 8-10 per cent.

One authority states that for every dollar paid railroads between 30 and 40 cents are devoted to capitalistic uses.

It is admitted without debate that our roads are suffering a great handicapped because of inadequate terminals, as well as because of inadequate equipment. It is also generally admitted that freight terminals for cities of the first and second and third classes should be removed from the congested parts of the cities to the suburbs, and that passenger terminals in cities of these classes should be consolidated into one or two union terminals for the benefit of both the roads and the public.

But roads say that they cannot secure funds for this work. It is suggested that a large part of the necessary funds could

Snow Bucking Outfit of Six Heavy Locomotives.

be secured through the sale of high priced city land now occupied as freight terminals and much larger areas in suburban land be bought for freight terminals.

The cost for the concentration of passenger terminals should be borne in some equitable proportion between the roads and the cities thus benfited, particularly as the building of such union terminals should be incorporated in the plans for the beautifying of the cities. The following few ways of saving in expenditures could be followed:

Stop rebating; dispense with high priced lawyers and materially reduce the amount and cost of litigation by settling out of court many cases on their merits. Refer many other cases to the Interstate Commerce Commission; settle damage claims quickly and fairly; join with the Interstate Commerce Commission in establishing fair and stable rates; stop exploitation of roads by the officers in conjunction with business interests doing contracting and selling with roads; discount practically all bills payable for equipment and supplies, absorb all private car lines; do all express business direct and in conjunction with the postal department; own coal mines, but mine and transport coal from such mines exclusively for railway use, mines to be operated on the open shop principle and the Federal Government to compel arbitration of disputes with the men and in the meantime the mines to be kept running; secure rigid laws against trespassing; adopt one standard coupler for the sake of economy and safety; double track; abolish capital grade crossings at level; and in cooperation with the Interstate Commerce Commission establish staple rates of wages under long time contracts; establish effective representation for labor in the directorate and in labor management through a special labor department as distinctive as are the traffic, mechanical and operating departments; install block signals; replace wooden cars with steel cars, and introduce other economies which are recognized as capable of being introduced under proper conditions.

POOR JUDGMENT IN SNOW-BUCKING.

The accompanying photographs which are published by courtesy of the Rio Grande Employes' Magazine illustrate a case, of most extraordinary poor judgment in clearing snow blocked track.

Figure 1 shows a train of six engines and six cabooses very evidently made up for the purpose of overcoming drifts by the method of "bucking" at speed. Two of the engines in this picture are completely concealed by flying snow. A mechanical official of judgment would never have permitted such a use of power had he been present to prevent. These engines probably average 75 tons in weight, with the cabooses, this train would weigh over one million pounds.

Figure 2 illustrates what might have been expected to happen. Three of the engines were reduced to scrap, the others being nearly derailed.

Such an accident can be charged to nothing other than poor judgement on the part of the official in charge of the make up of this outfit. It should be added that this did not take place on the Rio Grande.

ELECTRIC LOCOMOTIVES, FREDERICK RAILROAD.

The Frederick Railroad, of Frederick, Md., recently purchased two electric locomotives. One is a 30-ton Baldwin-Westinghouse locomotive for hauling freight between Thurmont and Frederick, Maryland, a distance of 17.37 miles, and for occasionally hauling grain between Frederick and Middletown, approximately eight miles; the other is a 22-ton locomotive of Brill-Westinghouse design. The sharpest curves are of 80-foot radii. The maximum grade between Frederick and Middletown, is 7 per cent and is part of a continuous rise of 600 feet in 2.5 miles. The maximum grade between Thurmont and Frederick is 2.588 per cent for 3,450 feet.

30-Ton Locomotive.

The mechanical parts of the 30-ton locomotive were furnished by the Baldwin Locomotive Works, Philadelphia,

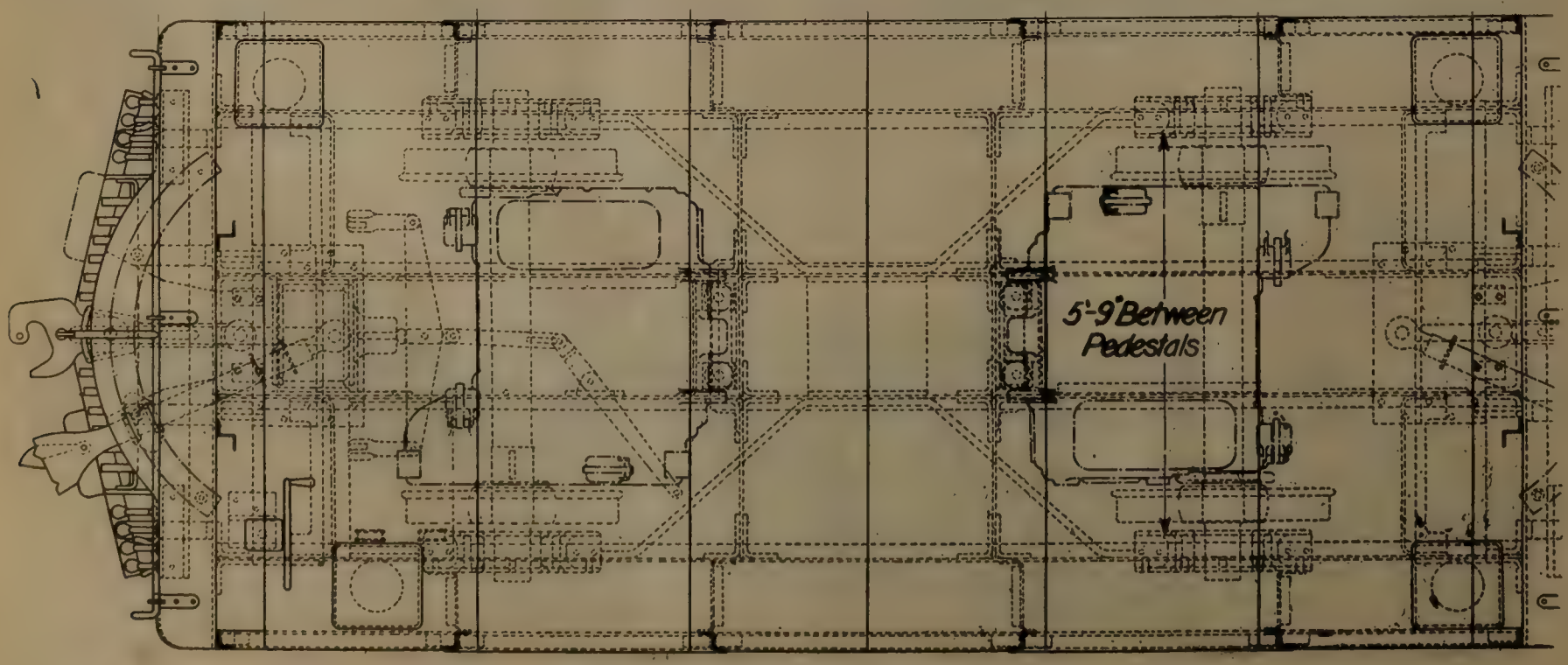
The Logical Result of Fool-Hardy Methods.

30-Ton Electric Locomotive for Frederick R. R.

Pa. The locomotive has a single rigid wheel base with two axles. It has a steel box cab and is arranged for double-end operation. The entire weight of the locomotive is carried by the two axles.

The frame of the locomotive is built of structural shapes wherever practicable. The longitudinal sills are four in number, the two center sills consisting of six-inch channels and the outside sills of 10-inch channels. The end bumpers are of wood, backed by steel plates. Diagonal bracing is worked in between the center and outside sills, and special attention has been given to providing ample transverse strength.

The journal boxes are guided in rigid pedestals, which are of cast steel and riveted to the outside frame channels. The pedestal boxes are of cast iron with bronze bearings, and are placed outside of the wheels, each box being sur-



Plan of 30-Ton Locomotive, Frederick R. R.

mounted by a half elliptic spring which supports the frame. The wheels are steel tired with cast iron centers.

The cab covers the entire frame and is substantially built of Z-bars and steel plates, covered with No. 14 B.W.S. sheet steel. It is 18 feet 4 inches long and 9 feet wide. Both end and side doors are provided. A clear space approximately 10 feet long is left in the center of the cab in which freight can be carried.

The locomotive as built weighs 25 tons complete. However, provision is made for weighing the locomotive to 30 tons in order to obtain the adhesion necessary for hauling the maximum loads. This is done by means of a cellar under the floor between the two axles, which may be filled with five tons of steel rails, in 6 foot lengths.

The principal dimensions of the locomotive are:

Diameter of driving wheels	36 ins.
Total wheel base	10 ft.
Length of cab, over bumpers	20 ft.
Width overall	9 ft.
Height from top of rail to center of drawbar	2 ft. 10½ ins.
Height from top of rail to top of cab	12 ft.
Weight including 10,000 pounds ballast	60,000 lbs.

The air brake equipment is the type 14-EL built by the Westinghouse Air Brake Co., and possesses both straight and automatic features. Air for the locomotive and train brakes is supplied by one D-3-EG compressor having a delivery capacity of approximately 25 cubic feet of free air per minute.

The electrical equipment was furnished by the Westinghouse Electric and Manufacturing Co. and consists of two No. 308-B-2, 600-volt commutating pole railway motors and type HL unit switch control.

To handle the large over load and the normal operating current of the locomotive, the Westinghouse unit switch, electro-pneumatic system of control was installed. This is the same as that employed in the locomotive built for the New York, New Haven and Hartford R. R., the Hoosac Tunnel (Boston & Maine R. R.), and the Pennsylvania Tunnel and Terminal Co., and the success it has given in the Fredrick locomotive as well as in many other small engines proves the electro-pneumatic control equally adaptable to either large or small equipments.

The hour rating of the 308-B-2 motor at 600 volts is 120 horsepower.

Because of the large size of the motor, the box type frame is used. This is made of steel cast in a single piece with large holes bored out at either end for seating the housings and for taking out the armatures endwise.

The complete weight of the motor is approximately 6,500 lbs. Part of this weight is borne by the two axle bearings, while the remainder is supported by a nose cast on the frame and resting upon the truck bolster.

The speed characteristic is inherently slow which, with the resulting high tractive effort and low power consumption, makes this motor particularly adapted to freight service. By virtue of the commutating-poles, enormous over loads in the motors are safely commutated.

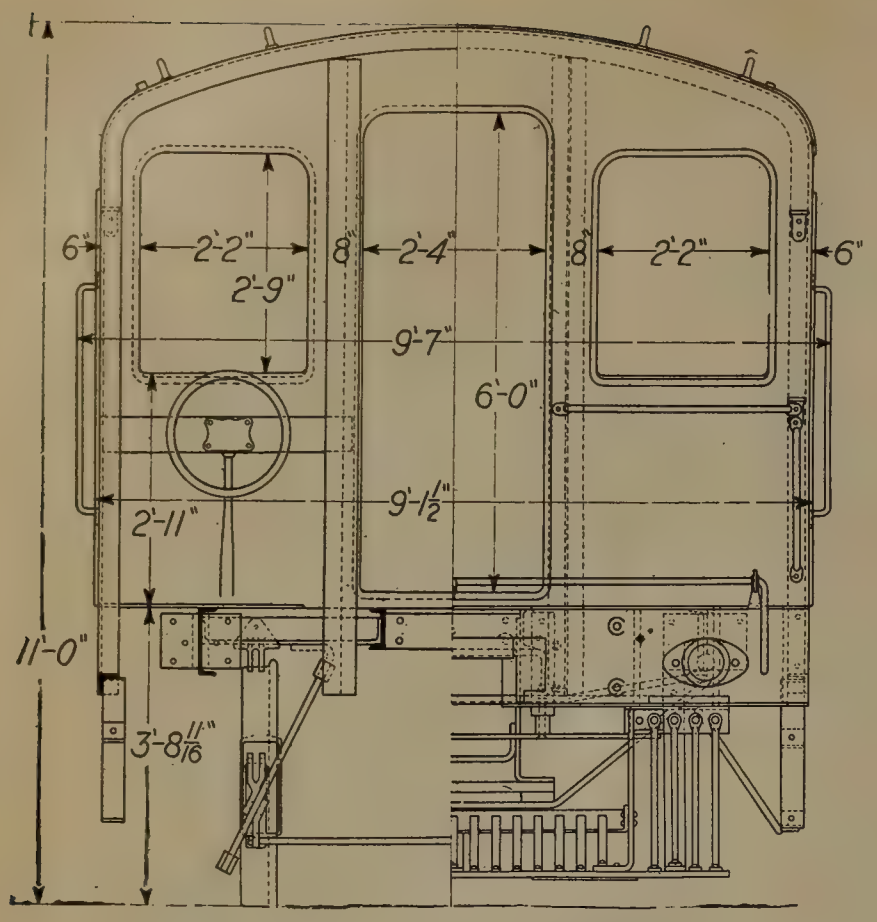
For one hour on 600 volts the locomotive will exert a tractive effort of 12,000 pounds at a speed of 7½ miles per hour. Momentarily the locomotive with sanded rails will exert a tractive effort of 17,500 pounds without ballast, or 21,000 pounds with ballast.

Expressed in terms of weight of train and grade it has sufficient capacity to handle a load of 200 tons on a grade of 2.588 per cent and may occasionally be required at times to haul a trailing load of 50 tons on a short grade of 7 per cent.

In switching service, on a straight level track, 31 cars each weighing 45 tons with load may be handled at 8.5 m.p.h. at 600 volts; and 8 cars at the same speed on a one per cent grade.

Auxiliary apparatus supplied with the locomotive consists

22-Ton Electric Locomotive for Frederick R. R.



End Elevation of 30-Ton Locomotive.

of a No. 13 Union standard Nuttall trolley, automatic M.C.B. radial couplers and bumpers, Tomlinson automatic radial couplers, Leach pneumatic sanders, and type LA Crouse-Hinds arc headlights. The latter are so arranged that both may be lighted at the same time, which is useful in switching. With the automatic M.C.B. radial coupler the locomotive can traverse a curve of 80 feet radius without uncoupling and with the Tomlinson coupler, a 40-ft. curve.

22-Ton Locomotive.

This locomotive was built by the J. G. Brill Company, Philadelphia, Pa., and is equipped with four Westinghouse No. 101-K, 35 H. P., 500-volt railway motors and "HL" control. It is substantially constructed, having a steel underframe. The side sills, stringers, cross ties and end sills are composed of 8, 7, 4 and 8-inch channels, respectively.

The body of the locomotive is of heavy wooded construction hexagonally shaped at each end. A plain arched roof runs the full length of locomotive. The top of the roof is covered with canvas and painted.

The locomotive body is mounted on two Brill No. 27-M.C.B.-1 trucks with 34 rolled steel wheels; 3½ tread, ⅞ x 1 3/16 flange; axles 4½ in diameter at motor bearing; 5½ at gear seat and 5 7/16 at the wheel seat.

The principal dimensions of the locomotive are:

Length over all	30 ft.
Width over side sheathing	8 ft.
Journals	3¾ in. x 7 in.
Standard gauge	4 ft. 8½ in.

The Westinghouse No. 101-K motor, used for driving this locomotive, is particularly adapted to slow speed freight and switching service, as it is ruggedly built and can take an axle as large as 7 inches in diameter.

The electrical characteristics of the 101-K motor are such that, due to its inherent slow speed, it is particularly adapted to freight and switching service handled with it.

The control equipment is Westinghouse double end "HL," which is particularly adapted to handle the heavy currents incident to locomotive service.

Some of the auxiliary apparatus supplied consists of:

Two Nuttall Trolleys.

Westinghouse Air Brakes.

Brill Dumpit Sanders.

M.C.B. couplers, standard M.C.B. height above the rail, 34½ in.

Tomlinson M.C.B. radial couplers, which will uncouple on 40 ft. radius curves.

Personals

G. E. Contant succeeds C. P. Burgman as master mechanic of the Ann Arbor at Owosso, Mich. W. D. Danley has been appointed general superintendent, with office at Owosso, Mich.

C. S. Taylor has been appointed general foreman of the Atlantic Coast Line at Wilmington, N. C. He succeeds H. B. Goodnight.

C. H. Sisler succeeds G. F. Weiseckle as master mechanic on the Baltimore & Ohio at Cumberland, Md. F. W. Boardman has been appointed general foreman of the B. & O. Southwestern at Washington, Ind., to succeed J. Conlin.

J. H. Dougherty has been appointed general manager of the Birmingham Belt, vice A. D. Lightner. His office is at Birmingham, Ala.

B. D. Coleman has been elected president of the Cambria & Indiana, with office at the Land Title Bldg., Philadelphia.

A. C. Mann succeeds R. L. Baugh as purchasing agent of the Central of Georgia. Office at Savannah, Ga.

F. S. Rockwell has been appointed division superintendent of the Chesapeake & Ohio at Covington, Ky. He succeeds T. J. Conners. E. R. Woody succeeds W. F. Jones as assistant master mechanic at Fulton, Va. W. H. Foster succeeds J. H. Bransford as general foreman at Thurmond, W.. Va., and J. C. Williams has been appointed to a similar position at Charlottesville, Va., vice F. B. Moss.

On April 1st, A. G. McClellan was appointed road master mechanic of the Chicago & Alton and W. E. Ladley was appointed shop master mechanic. Both with offices at Bloomington, Ill. W. H. Cornell has been appointed superintendent of transportation of both the Alton and the "Clover Leaf."

James Dickson has been appointed general foreman of the locomotive and car department of the Burlington at Quincy, Ill.

Frank Rusch has been appointed acting general master mechanic of the Chicago, Milwaukee & Puget Sound, vice N. M. Maine. His office is at Tacoma, Wash. W. O. Davis succeeds M. Parkinson as general foreman of the car department at Milwaukee, Wis.

John J. O'Neil succeeds E. B. Thompson as superintendent of motive power and machinery of the Chicago, St. Paul, Minneapolis & Omaha. Office at St. Paul, Minn.

M. L. Phelps has been appointed superintendent of the Colorado Midland to succeed F. B. Miller, resigned. His headquarters are at Colorado City, Colo.

J. L. Smith succeeds M. J. Malican as general foreman, motive power department, of the Delaware, Lackawanna & Western at East Buffalo, N. Y. Also, Robert Morton succeeds M. E. Williams at Scranton, Pa.

F. T. McDonald has been appointed assistant master mechanic of the Utah lines of the Denver & Rio Grande with offices at Helper, Utah.

John A. Ralston has been appointed mechanical engineer of the Etna & Montrose, Mercer Valley, Pittsburgh & Ohio Valley, St. Clair Terminal and the Union R. R. His office is at Pittsburgh.

T. McHattie has been appointed master mechanic of the Eastern division of the Grand Trunk with headquarters at Montreal, Que. He succeeds J. Duguid.

J. J. Cotter succeeds H. L. Hill as superintendent of transportation of the Guatemala Ry. at Zacapa, Guatemala.

H. B. Brown has been appointed assistant superintendent of machinery of the Illinois Central at Memphis, Tenn. J. I. Haller succeeds Mr. Brown as master mechanic at Memphis.

D. C. Ross succeeds J. A. Chubb as master car builder of the Michigan Central at West Detroit, Mich.

W. J. Shreve has resigned as master mechanic of the Minneapolis & Rainy River.

P. E. Crowley has been appointed general manager of the New York Central & Hudson River with offices at the Grand Central Terminal, New York. H. L. Ingersoll has been appointed assistant general manager with office at New York.

J. C. Haggart has been appointed terminal train master of the Pere Marquette vice F. G. Bement. His office is at Saginaw, Mich.

The San Diego & South Eastern Ry. was incorporated on March 2 and has taken over the properties formerly operated under the names of the San Diego & Cuyamaca Ry. and San Diego Southern Ry.

Peter Vosen succeeds E. O. Shively as assistant master mechanic of the Wabash at Decatur, Ill.

P. C. Smith has been appointed mechanical engineer of the Chicago, St. Paul, Minneapolis & Omaha, with office at St. Paul. Mr. Smith was formerly chief draftsman.

Chas. Landberg succeeds J. B. Wyler as general foreman of the Spokane, Portland & Seattle at Vancouver, Wash.

A. W. Thompson, formerly general manager, has been elected vice president of the Baltimore & Ohio, and the Cincinnati, Hamilton & Dayton, in charge of operation. His office is at Baltimore, Md.

H. C. Nutt has resigned as vice president of the Northern Pacific to become general manager of the San Pedro, Los Angeles & Salt Lake with office at Los Angeles, Cal. He succeeds R. E. Wells.

J. A. Haley succeeds M. Dailey as master mechanic of the Bellingham Bay & British Columbia with office at Bellingham, Wash.

V. C. Randolph has been appointed master mechanic of the Erie at Avon, N. Y. Mr. Randolph was born at Ranholph, N. Y., in 1869 and attended the common schools at Salamanca, N. Y. He began work in 1882 on the Erie as a machinist apprentice. He worked as a machinist until July, 1888, at which time he went on the Alleghany division as a fireman. He was promoted to an engineer in April, 1891 and continued in this capacity until July, 1902, at which time he secured a leave of absence to go with the International Correspondence School as a locomotive and air brake instructor. On November, 1904, he returned to the Erie as general air brake inspector and in January, 1910 was promoted to supervisor of locomotive operation of the Alleghany and Bradford divisions which position he held until his recent appointment.

H. B. Brown.

H. C. Nutt.

V. C. Randolph.

Among The Manufacturers

New Literature

Descriptive leaflet 2440, issued by the Westinghouse Electric Manufacturing Company, describes the Westinghouse split frame commutating pole railway motor 323-A. This motor has a rating of 32 h. p. at 500 volts and 38 h. p. at 600 volts.

* * *

The Smooth-On Mfg. Co. of Jersey City, N. J. has issued a booklet dealing with Smooth-On iron cement No. 7 for use in concrete work. It describes the various uses of this cement for repairing cracks and leaks, and also for waterproofing concrete structures.

* * *

The Watson-Stillman Company, of New York, has just issued Catalog No. 85. hydro-pneumatic wheel presses. This catalog describes and lists its line of full hydro-pneumatic wheel presses and those with hydro-pneumatic pull-back only. Seventy-six types and sizes are listed.

* * *

The Universal Machine Co., of Toledo, Ohio, has issued an attractive catalog of Toledo marine motors and accessories. The foreword says that "we do not make high powered racing engines, nor do we make the diminutive type known as a 'rat and a half' power, but devote all our energies to sizes suitable to launches from 16 to 30 feet long." The engines range from 3 h. p. to 18 h. p., with from one to three cylinders. A stationary engine is also manufactured.

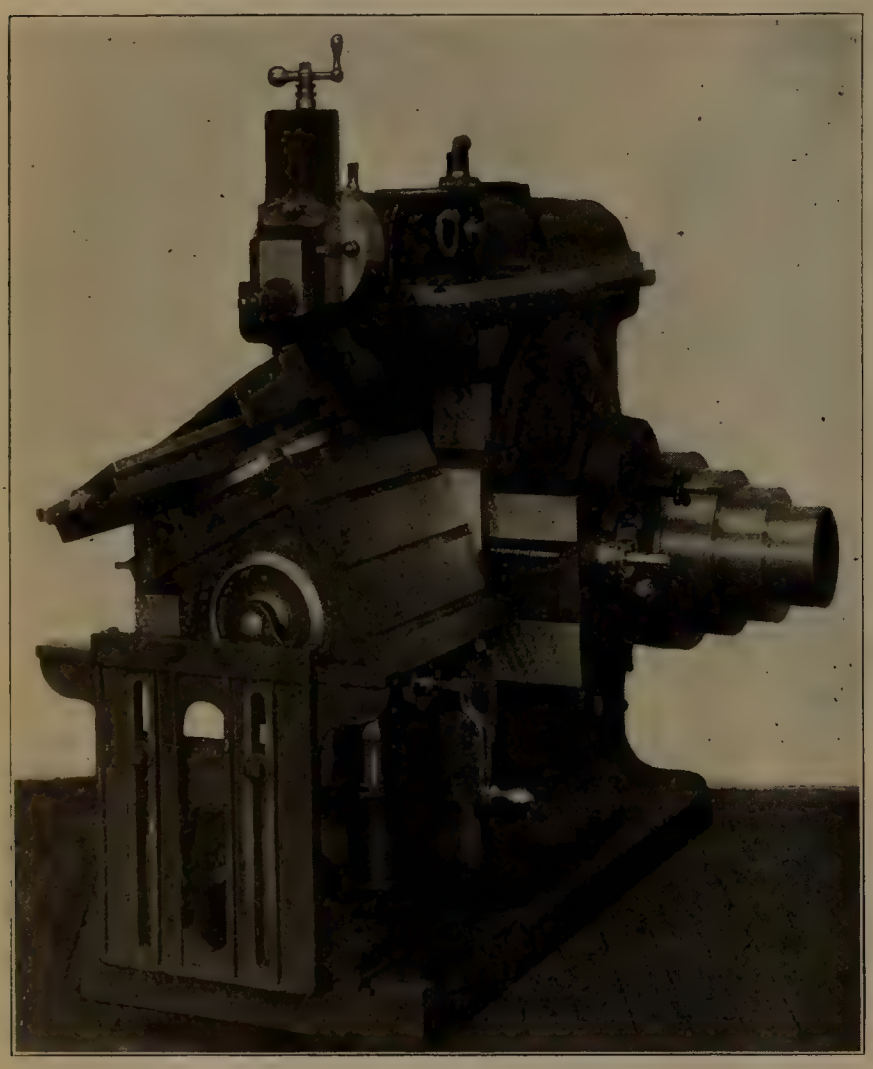
* * *

The Scully Steel & Iron Co. has issued its annual Blue Book for 1912, which is a complete catalog and stock list for the year. A number of tables and other information covering riveted and butt joints, bursting pressure of boiler shells, etc., has been included by courtesy of the Hartford Steam Boiler Inspection and Insurance Co.

THE CARBORUNDUM EXHIBIT AT ATLANTIC CITY.

The master mechanic and the shop superintendent is ever on the alert to learn of shop equipment that will tend to decrease the cost of production, to save time and to produce better work. In every modern railroad shop the grinding wheel has become a most important factor in bringing about just such results and it will therefore be of decided interest to all railway men who attend the Atlantic City conventions to pay a visit to the exhibit of Carborundum products at booths Nos. 149-151, Machinery Hall.

It is not the policy of The Carborundum Co. to simply give an attractive display of grinding wheels. The master mechanic and the shop superintendent is always anxious to be shown just



Stockbridge Swiveling Knee Shaper.

what a grinding wheel will do. He is anxious to see the wheels in actual operation, grinding materials and tools just as they would under actual shop conditions. The Carborundum exhibit therefore will be a working exhibit. Carborundum and Aloxite wheels will be shown under actual working conditions and every possible effort will be made to demonstrate to those who visit the exhibit the actual cutting qualities of these wheels.

The exhibit will be equipped with a universal grinder, a drill grinder, a heavy floor grinding machine and a cut off machine. A practical man will be in charge and grinding tests will be carried on under almost the same conditions as would prevail in the railroad shop.

Of particular interest to the master mechanic will be the demonstration of Aloxite wheels for tool room work. During the past year or so the Aloxite wheel has made some wonderful efficiency records in the grinding of high speed steel tools, reamers, cutters, etc. Aloxite is the ideal material for steel grinding. It is hard, sharp, tough, cuts fast, clean and cool, and shows remarkable durability. These wheels will be shown to advantage in tool grinding and the mechanic in charge of the Carborundum exhibit will be glad at any time to demonstrate the adaptability and superiority of Aloxite wheels for this class of work.

Carborundum, for many years has enjoyed an enviable reputation in the railroad world for its unquestioned superiority in grinding cast iron, brass, bronze; the grinding of car wheels and for general machine shop work. Carborundum wheels will be shown in actual operation on these classes of work and it will indeed be well worth the time of any master mechanic or superintendent to visit the Carborundum exhibit and see for himself the cutting powers of these wheels.

Master car builders, too, will find it interesting as well as profitable to visit the Carborundum exhibit and learn something regarding the records being made by Aloxite wheels for knife grinding and saw gumming and Carborundum Brand Garnet paper and cloth for general sanding purposes.

Aloxite wheels are particularly adapted to the grinding of wood working knives and general wood working tools and for saw gumming. Aloxite wheels cut fast, clean and cool. They do not burn or draw the temper, hold their shape and show long life. These are the ideal characteristics of the ideal tool grinding wheel.

Carborundum Brand Garnet paper and cloth are fast cutting and show wonderful durability. Only the best of paper and cloth, the purest of glue and the sharpest and cleanest of Garnet grain enter into their making. These products are making some wonderful efficiency and economy records in hundreds of wood working plants and are well worth the consideration and attention of the master car builders who attend the convention.

Mr. R. S. Marvin, Sales Manager of The Railroad Department of The Carborundum Co., will be in charge of the exhibit, assisted by Mr. C. C. Schumaker, W. W. Sanderson, C. C. Lathrop, R. H. Hogg and J. P. Hanlon.

BADGER WATER-OIL SEPARATOR.

Users of high potential electric current will be interested in a new device for separating water from transformer oil. The device is manufactured by the Wisconsin Foundry & Machine Co., Madison, Wis.

E. L. Leasman, a representative of this company, states that transformer oils which have lost a great deal of their insulating qualities can regain same to the extent of practically 100 per cent by the use of this means of extracting all moisture. An instance related is that of a test at the plant of one of the largest hydro-electric power companies in Wisconsin, the lines of this concern carrying the highest voltage of any in the state.

Oil which broke down at 30,000 volts with test points 2 in. apart was filtered in the "Badger" separator and was then again tested and it was found not possible to break it down at 50,000 volts. The construction of the device is simple and it can be operated by the regular power plant attendants.

STOCKBRIDGE SHAPER WITH SWIVELING KNEE.

For about ten years the Stockbridge Machine Co., of Worcester, Mass., has been equipping its standard box type knee shaper with a knee support. The use of high speed steels and, in consequence, the greater rigidity required in the shaper knee, has necessitated in the last few years the general use of a knee support by all shaper builders. A knee support for swiveling knee which would give it a support when in any position, however, is a new feature which is now being furnished on Stockbridge machines. This firm is now equipping its 16, 20 and 24-inch back geared shapers and 18-inch all-geared shaper with a support as illustrated. The knee support furnished with swiveling knee is the same type as used previously in connection with standard type box knee.

The knee is revolved by means of worm and gear operated by a handle conveniently located on the working side of knee. A graduated dial reading to degrees on the front of the knee permits the setting of knee to any angle for planing bevels. One side of the knee can be furnished with a tilting top making it possible to plane compound angles.

LIST OF EXHIBITORS, ATLANTIC CITY CONVENTIONS.

The railway supply concerns which will exhibit at the June conventions of the Master Car Builders' and American Railway Master Mechanics' Association are named in the following list:

Acme Supply Co., Steger Bldg., Chicago, Ill.
Ajax Mfg. Co., Cleveland, O.
American Abrasive Metals Co., 50 Church St., New York, N. Y.
American Arch Co., 30 Church St., New York, N. Y.
American Balance Valve Co., Jersey Shore, Pa.
American Brake Co., St. Louis, Mo.
American Brake Shoe & Fdry. Co., Mahwah, N. J.
American Brass Co., Ansonia, Conn.
American Car & Fdry. Co., 165 Broadway, New York, N. Y.
American Locomotive Co., 30 Church St., New York, N. Y.
American Nut & Bolt Fastener Co., Box 996, Pittsburgh, Pa.
American Roll Gold Leaf Co., Providence, R. I.
American Steel Foundries, Commercial National Bank Bldg., Chicago, Ill.
American Tool Works, Cincinnati, O.
American Vanadium Co., Frick Bldg., Pittsburgh, Pa.
Automatic Ventilator Co., 120 Liberty St., New York, N. Y.
American Mason Safety Tread Co., 50 Church St., New York, N. Y.
Anchor Packing Co., Lafayette Bldg., Philadelphia, Pa
Barco Brass & Joint Co., 250 N. Jefferson St., Chicago, Ill.
Berry Bros., Ltd., Detroit, Mich.
Best Mfg. Co., Pittsburgh, Pa.
Best, W. N., 11 Broadway, New York, N. Y.
Bethlehem Steel Co., South Bethlehem, Pa.
Bettendorf Axle Co., Bettendorf, Ia.
Blackall, Robert H., Farmers' Bank Bldg., Pittsburgh, Pa.
Boss Nut Co., Coml. Natl. Bank Bldg., Chicago, Ill.
Bowser & Co., Inc., S. F., Ft. Wayne, Ind.
Brunix Mfg. Co., 2120 Land Title Bldg., Philadelphia, Pa.
Buckeye Steel Castings Co., Columbus, O.
Buffalo Brake Beam Co., 30 Pine St., New York, N. Y.
Bullard Machine Tool Co., Bridgeport, Conn.
Buyers' Index Co., 445 Plymouth Place, Chicago, Ill.
Brown Automatic Connector Co., Avenue Bank & Trust Co., Chattanooga, Tenn.
Cambria Steel Co., Johnstown, Pa.
Camel Co., McCormick Bldg., Chicago, Ill.
Carborundum Co., Niagara Falls, N. Y.
Carey Co., Philip, Lockland, Cincinnati, O.
Carnegie Steel Co., Carnegie Bldg., Pittsburg, Pa.
Carter Iron Co., Farmers' Bank Bldg., Pittsburgh, Pa.
Chase & Co., L. C., 89 Franklin St., Boston, Mass.
Chicago Car Door Co., Monadnock Block, Chicago, Ill.
Chicago Car Heating Co., Railway Exchange, Chicago, Ill.
Chicago Pneumatic Tool Co., 343 S. Dearborn St., Chicago, Ill.
Chicago Railway Equipment Co., McCormick Bldg., Chicago, Ill.
Chicago Steel Car Co., First Natl. Bank Bldg., Chicago, Ill.
Chicago Varnish Co., People's Gas Bldg., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Coe Mfg. Co., W. H., Providence, R. I.
Collins Metallic Packing Co., Bourse Bldg., Philadelphia, Pa.
Colonial Steel Co., 324 Fourth Ave., Pittsburgh, Pa.
Commonwealth Steel Co., Pierce Bldg., St. Louis, Mo.
Consolidated Car Heating Co., Singer Tower, New York, N. Y.
Crane Co., 1214 S. Canal St., Chicago, Ill.
Crosby Steam Gage & Valve Co., 40 Central St., Boston, Mass.
Crucible Steel Co. of America, Oliver Bldg., Pittsburgh, Pa.
Curtain Supply Co., 320 W. Ohio St., Chicago, Ill.
Dahlstrom Metallic Door Co., Jamestown, N. Y.
Damascus Brake Beam Co., Cleveland, O.
Davis-Bournonville Co., 90 West St., New York, N. Y.
Davis-Solid Truss Brake Beam Co., Wilmington, Del.
Dearborn Drug & Chemical Works, McCormick Bldg., Chicago.
Detroit Lubricator Co., Detroit, Mich.
Dickinson, Inc., Paul, Security Bldg., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.
Dressel Railway Lamp Works, 3860 Park Ave., New York, N. Y.
Duff Mfg. Co., North Side, Pittsburgh, Pa.
Durbin Automatic Train Pipe Connector Co., Chemical Bldg., St. Louis, Mo.
Deforest Sheet & Tin Plate Co., Niles, O.
Duntley-Keller Pneumatic Tool Co., Harvester Bldg., Chicago, Ill.
Eagle Glass & Mfg. Co., Wellsburg, W. Va.
Economy Car Heating Co., 141 Cedar St., New York, N. Y.
Edison Storage Battery Co., Orange, N. J.
Edwards Co., O. M., Syracuse, N. Y.
Electric Controller & Mfg. Co., 50 Church St., New York, N. Y.
Electric Storage Battery Co., 19th St. and Allegheny Ave., Philadelphia, Pa.
Emery Pneumatic Lubricator Co., 1932 N. Broadway, St. Louis, Mo.
Fairbanks Co., 416 Broome St., New York, N. Y.
Farlow Draft Gear Co., Maryland Trust Bldg., Baltimore, Md.
Flannery Bolt Co., Frick Bldg., Pittsburgh, Pa.
Forged Steel Wheel Co., Frick Bldg., Pittsburgh, Pa.
Forsyth Bros. Co., McCormick Bldg., Chicago, Ill.
Foster Co., Walter H., 50 Church St., New York, N. Y.
Franklin Mfg. Co., Franklin, Pa.
Franklin Railway Supply Co., 30 Church St., New York, N. Y.
Frost Railway Supply Co., Penobscot Bldg., Detroit, Mich.
Galena Signal Oil Co., 26 Broadway, New York, N. Y.
Garlock Packing Co., Palmyra, N. Y.
General Electric Co., Schenectady, N. Y.
General Railway Supply Co., 531 Marquette Bldg., Chicago, Ill.
Gold Car Heating & Lighting Co., 17 Battery Place, New York, N. Y.
Goldschmidt Thermit Co., 90 West St., New York, N. Y.
Gould Coupler Co., 347 Fifth Ave., New York, N. Y.
Gould & Eberhardt, Newark, N. J.
Greene, Tweed & Co., 109 Duane St., New York, N. Y.
Greenlow Mfg. Co., 141 Milk St., Boston, Mass.
Griffin Wheel Co., 1214 McCormick Bldg., Chicago, Ill.
Grinden Art Metal Co., 43 Walton St., Brooklyn, N. Y.
Grip Nut Co., Old Colony Bldg., Chicago, Ill.
Halcomb Steel Co., 45 N. Seventh St., Philadelphia, Pa.
Hale & Kilburn Co., 1800 Lehigh Ave., Philadelphia, Pa.
Hammett, H. G., 476 Eighth St., Troy, N. Y.
Harrington, Son & Co., Inc., Edwin, 17th and Callowhill Sts., Philadelphia, Pa.
Hewitt, H. H., 111 Broadway, New York, N. Y.
Heywood Bros. & Wakefield Co., Wakefield, Mass.
Highley Machine Co., 93 Liberty St., New York, N. Y.
Hobart-Allfree Co., Old Colony Bldg., Chicago, Ill.
Home Rubber Co., Trenton, N. J.
Hubbard & Co., 62d St. and A. V. Ry., Pittsburgh, Pa.
Hunt Co., C. W., West New Brighton, N. J.
Hunt-Spiller Mfg. Corp., 383 Dorchester Ave., Boston, Mass.
Illinois Steel Co., Coml. Natl. Bank Bldg., Chicago, Ill.

Independent Pneumatic Tool Co., 1807 Michigan Ave., Chicago, Ill.
International Oxygen Co., 115 Broadway, New York, N. Y.
Jacobs-Shupert U. S. Fire Box Co., 30 Church St., New York, N. Y.
Jenkins Bros., 80 White St., New York, N. Y.
Jessop & Sons, Inc., Wm., 91 John St., New York, N. Y.
Johns-Manville Co., H. W., 100 William St., New York, N. Y.
Joliet Railway Supply Co., 500 Fisher Bldg., Chicago, Ill.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
Joyce-Cridland Co., 329 Lindon Ave., Dayton, O.
Keystone Drop Forge Works, Central and Delaware Aves., Chester, Pa.
Keystone Lubricating Co., 21st and Clearfield Sts., Philadelphia, Pa.
Keyoke Railway Equipment Co., Coml. Natl. Bank Bldg., Chicago, Ill.
Knight Pneumatic Sander Co., Huntington, Ind.
Landis Machine Co., Waynesboro, Pa.
Lehon Co., W. 45th St., Chicago, Ill.
Locomotive Improvement Co., Clinton, Ia.
Locomotive Superheater Co., 30 Church St., New York, N. Y.
Lucus Machine Tool Co., E. 99th St., Cleveland, O.
Lunkenheimer Co., Box 876, Cincinnati, O.
Main Belting Co., 1241 Carpenter St., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., 85 Liberty St., New York, N. Y.
Manufacturers' Exhibit of Railway Supplies, Karpen Bldg., Chicago, Ill.
Massachusetts Mohair Plush Co., 200 Devonshire St., Boston, Mass.
Matthews-Davis Tool Co., 3722 Forest Park Blvd., St. Louis, Mo.
Midvale Steel Co., 115 Washington St., New York, N. Y.
Mid-Western Car Supply Co., People's Gas Bldg., Chicago, Ill.
Milburn Co., Alexander, 507 W. Lombard St., Baltimore, Md.
Moren Flexible Steam Joint Co., 115 N. Third St., Louisville, Ky.
Mudge & Co., Burton W., People's Gas Bldg., Chicago, Ill.
McConway & Torley Co., 48th St. and A. V. Ry., Pittsburgh, Pa.
McCord & Co., People's Gas Bldg., Chicago, Ill.
McCord Mfg. Co., People's Gas Bldg., Chicago, Ill.
McGraw Publishing Co., 239 W. 39th St., New York, N. Y.
Nathan Mfg. Co., 85 Liberty St., New York, N. Y.
National Lock Washer Co., Johnson and Hermon Sts., Newark, N. J.
National Malleable Castings Co., Cleveland, O.
National Tube Co., Frick Bldg., Pittsburgh, Pa.
Nazel Engineering & Machine Works, 4041 N. Fifth St., Philadelphia, Pa.
Newhall Engineering Co., Geo. M., Morris Bldg., Philadelphia, Pa.
Newton Machine Tool Works, Inc., 24th and Vine Sts., Philadelphia, Pa.
New York Air Brake Co., 165 Broadway, New York, N. Y.
Nickel-Chrome Chilled Car Wheel Co., Frick Annex, Pittsburgh, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York, N. Y.
Norton, Inc., A. O., 285 Congress St., Boston, Mass.
Norton Co., Worcester, Mass.
Pantasote Co., 11 Broadway, New York, N. Y.
Parkesburg Iron Co., Parkesburg, Pa.
Parsons Eng. Co., Equitable Bldg., Wilmington, Del.
Pease Co., C. F., 166 W. Adams St., Chicago, Ill.
Pennsylvania Flexible Metallic Tubing Co., 17 Battery Place, New York, N. Y.
Pilliod Co., Swanton, O.
Pittsburgh Equipment Co., House Bldg., Pittsburgh, Pa.
Pneumatic Jack Co., Paul Jones Bldg., Louisville, Ky.
Pocket List of Railroad Officials, 75 Church St., New York, N. Y.
Pressed Steel Car Co., 24 Broad St., New York, N. Y.
Pyle National Electric Headlight Co., Karpen Bldg., Chicago, Ill.
Pyrene Mfg. Co., 1358 Broadway, New York, N. Y.
Railway Age Gazette, 85 Fulton St., New York, N. Y.
Railway and Engineering Review, Ellsworth Bldg., Chicago, Ill.
Railway List Co., 431 S. Dearborn St., Chicago, Ill.
Railway Materials Co., Old Colony Bldg., Chicago, Ill.
Railway Utility Co., Rookery, Chicago, Ill.
Reliance Electric & Eng. Co., Cleveland, O.
Remy Electric Co., Anderson, Ind.
Restein Co., Clement, 133 N. 2d St., Philadelphia, Pa.
Robinson Coupler Co., Westory Bldg., Washington, D. C.
Rochester Germicide Co., Rochester, N. Y.
Rubberset Co., Newark, N. J.
Safety Car Heating & Lighting Co. 2 Rector St., New York, N. Y.
Scarritt-Comstock Furniture Co., Broadway & Locust Sts., St. Louis, Mo.
Scullin-Gallagher Iron & Steel Co., 6700 Manchester Ave., St. Louis, Mo.
Sellers & Co., Inc., Wm., 1600 Hamilton St., Philadelphia, Pa.
Shelby Steel Tube Co., Frick Bldg., Pittsburgh, Pa.
Simplex Railway Appliance Co., Coml. Natl. Bank Bldg., Chicago, Ill.
Sprague Electric Works of G. H. Co., 527 W. 24th St., New York, N. Y.
Standard Coupler Co., 2 Rector St., New York, N. Y.
Standard Roller Bearing Co., 50th St. and Lancaster Ave., Philadelphia, Pa.
Standard Steel Car Co., Frick Bldg., Pittsburgh, Pa.
Storrs Mica Co., Owego, N. Y.
Street, Clement F., Box 192, Schenectady, N. Y.
Swedish Iron & Steel Corp., 12 Platt St., New York, N. Y.
Symington Co., T. H., Maryland Trust Bldg., Baltimore, Md.
Sinclair Co., Angus, 114 Liberty St., New York, N. Y.
Taber Mfg. Co., 18th and Hamilton Sts., Philadelphia, Pa.
Templeton, Kenly & Co., Ltd., 1335 Solan St., Chicago, Ill.
Topping Bros., 122 Chambers St., New York, N. Y.
Tyler Co., W. S., Cleveland, O.
Union Draft Gear Co., Monadnock Block, Chicago, Ill.
Union Spring & Mfg. Co., Oliver Bldg., Pittsburg, Pa.
U. S. Light & Heating Co., 30 Church St., New York, N. Y.
U. S. Metal & Mfg. Co., 165 Broadway, New York, N. Y.
U. S. Metallic Packing Co., 429 13th St., Philadelphia, Pa.
Valentine Co., 257 Broadway, New York, N. Y.
Van Beuren, Walter B. L., 141 Cedar St., New York, N. Y.
Van Dorn & Dutton Co., Cleveland, O.
Virginia Equipment Co., Spitzer Bldg., Toledo, O.
Vixen Tool Co., 5001 Lancaster Ave., Philadelphia, Pa.
Ward Equipment Co., 141 Cedar St., New York, N. Y.
Warner & Swasey Co., Cleveland, O.
Watson-Stillman Co., 50 Church St., New York, N. Y.
Welsbach Co., Gloucester, N. J.
West Disinfecting Co., 2 E. 42d St., New York, N. Y.
Western Railway Equipment Co., 705 Olive St., St. Louis, Mo.
Westinghouse Air Brake Co., East Pittsburgh, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Westinghouse Machine Co., East Pittsburgh, Pa.
Wheel Truing Brake Shoe Co., Detroit, Mich.
Williams Co., Inc., G. H., Rockefeller Bldg., Cleveland, O.

Wilmarth & Morman Co., Grand Rapids, Mich.
Wilson Remover Co., Hudson Terminal Bldg., New York, N. Y.
Wood, Guilford S., Great Northern Bldg., Chicago, Ill.
Yale & Towne Mfg. Co., 9 Murray St., New York.
Zug Iron & Steel Co., P. O. Box 1053, Pittsburgh, Pa.

Track Exhibitors.

McKeen Motor Car Co., Omaha, Neb.
Standard Car Truck Co., McCormick Bldg., Chicago, Ill.

Industrial Notes

Herbert Wolff, mechanical engineer of the American Car & Foundry Co., New York, has been appointed assistant to Vice-President J. M. Buick, with office in St. Louis, Mo.

The American Car Screen Co., Pittsburg, Pa., has received an order from the Pennsylvania to equip 11 new steel dining cars with the "Scott" No. 2 adjustable car window screens. This company has just completed equipping three new buffet chair cars for the B., R. & P. Ry., and also equipped a sleeping car for the Canadian Pacific.

A. M. Kittredge.

Arthur M. Kittredge has resigned as president of the Barney & Smith Car Co., Dayton, Ohio. No successor has as yet been elected.

The W. K. Kenly Co. announces the change of its name after May 1, 1912, to the Universal Railway Supply Co., with offices in the People's Gas Bldg., Chicago, Ill.

The Curtain Supply Co., Chicago, announces the appointment of Fred M. Egolf as a new western representative, with office in Chicago.

The Railway Materials Co. announces the removal of its offices on May 1, 1912, from the Old Colony Bldg., Chicago, to Room 217 Railway Exchange Bldg., in the same city.

The Joliet Railway Supply Co., Joliet, Ill., announces that in addition to the Perry anti-friction side bearings it has made arrangements for the exclusive manufacture and sale of the improved Hartman anti-friction center plate. This company is now equipping and will operate a large plant at Fortieth street and Princeton avenue, Chicago, to which point it will remove its general office from Joliet and its Chicago office from the Fisher Bldg., maintaining sales offices only at the Karpen Bldg., Chicago; Mutual Bldg., Richmond, Va., and Syndicate Trust Bldg., St. Louis, Mo.

The Niles- Bement-Pond Co., New York, will on May 1 move its Chicago office from the Comercial National Bank Bldg. to the McCormick Bldg., Chicago.

The Scullin-Gallagher Iron & Steel Co., St. Louis, Mo., has moved its New York office from 1 Wall street to the Grand Central Terminal.

The Miller Heating Co., of Chicago has just received contract from the Kansas City Terminal for the installation of a Miller hot water washout and refilling system in their new 12-stall engine house at Kansas City, Kans. This is of interest because of the fact that this is the first time in the history of such an installation in the United States that same has been installed in a square or rectangular engine house.

The Chicago Car Door Co. has received an order for 510 sets of the Chicago car door from the Chicago, Milwaukee & St. Paul. These doors are to be applied on an order of automobile cars now under construction at the Milwaukee shops of that railway.

R. A. Dugan, formerly assistant general manager of the Southern Railway, has gone to the Scullin-Gallagher Iron & Steel Co., St. Louis, Mo., to take charge of the sales department of its Chicago office.

The Edwards Manufacturing Co., Columbia, S. C., has been incorporated to manufacture railway appliances. The incorporators are: James B. Edwards and George Edwards. The capital stock is $12,000.

George E. Fox, formerly purchasing agent of the Guayaquil & Quito, Ecuador, has entered the sales department of the Curtain Supply Co., Chicago, with the office in New York.

Mr. George F. Stalley, purchasing agent of the Browning Engineering Co., Cleveland, Ohio, has also been appointed advertising manager of that company, succeeding Mr. L. C. Pelott, resigned.

Regarding the impression which seems to have become quite general that the Million Dollar Pier at Atlantic City has burned, J. D. Conway, secretary of the Railway Supply Manufacturers' Association, announces that the rumor is an error due to the similarity of names. One of the piers did burn, but the June exhibit will be held on the Million Dollar pier, as usual.

The Laconia Car Co., Boston, Mass., has moved its general offices from 141 Milk street to 60 Congress street.

R. L. Langtim has been appointed mechanical superintendent of the Western Railway Equipment Co., St. Louis, Mo.

The Ralston Steel Car Co., Columbus, Ohio, is making extensive improvements by enlarging buildings and adding new machinery.

The Coppus Engineering & Equipment Co., Worcester, Mass., has been incorporated in Massachusetts to deal in and make machinery and mechanical appliances, particularly the Coppus turbo blower, a device for increasing the capacity of boilers and chimney drafts, invented by Francis H. C. Coppus, of Worcester. The officers are: Pres. and Treas., Frans H. C. Coppus; vice-pres., Fritz W. Schmidt; directors, Frans H. C. Coppus, Linwood M. Erskine and Fritz W. Schmidt, all of Worcester.

Mr. H. L. Waterman, who has been general New York sales agent of the Cambria Steel Co. since 1896, has resigned, and Mr. L. B. Morris, who has been New York sales agent in charge of merchant steel since 1900, has assumed entire charge of the New York office under the title of district sales manager.

Recent Railway Mechanical Patents

SLACK ADJUSTER FOR BRAKES.

1,023,790—J. J. Acker, Horton, Kan.

In combination, a push rod, means for actuating the push rod, a dog controlled ratchet movable in one direction with relation to the push rod, a cylinder lever pivotally connected with the ratchet, an adjusting rod having a slot therein, and with which the cylinder lever is connected, and a dog controlled ratchet for permitting movement of the adjusting rod in one direction only, the movement of the ratchet associated with the push rod by the cylinder lever compensating for the movement of the adjusting rod by the lever.

JOURNAL BOX SECURING MECHANISM.

1,023,809—A. O. Buckins, Jr., assignor to the National Malleable Castings Co., Cleveland, O.

In a car truck, a side frame having a seat for a journal box opened at the bottom and side, a journal box having a retainer with a lateral opening, and a securing bolt or strap extending through the retainer and securing the box to the side frame.

CAR COUPLING.

1,023,818—J. A. Cowie, Summerset, Ia.

A car coupler comprising a draw head provided with an elongated slot on one side and a lever opening upon the opposite side, a knuckle pivoted to the draw head, a knuckle operating rod connected with the knuckle and adapted to work through the elongated slot in the draw head, a turn bar pivoted within the draw head and connected to the knuckle operating rod, a controlling lever connected to the turn bar and adapted to work through the lever opening in the draw head, and means for locking the parts against movement when the coupler is in closed position.

CAR DOOR.

1,023,833—F. F. Gaines, Savannah, Ga.

The combination with the side of a car having a door opening therein, of a door adapted to be moved into the door opening flush with the side of the car, a keeper embedded in the side of the car and having a lever-engaging portion substantially flush with the side of the car, and a locking lever pivoted on the door and having a keeper-engaging portion adapted to pull the door into the door opening, when it is moved into one of its positions and being also adapted to move the door outward when it is moved to its reverse position, the lever having a separate member in co-operative relation to the keeper-engaging portion and adapted to bear against the outer face of the lever-engaging portion of the keeper when the lever is moved to the reverse position to effect the withdrawal of the door from the door opening.

AUTOMATIC COAL FEED.

1,023,935—Charles Hocker, Huntingburg, Ind.

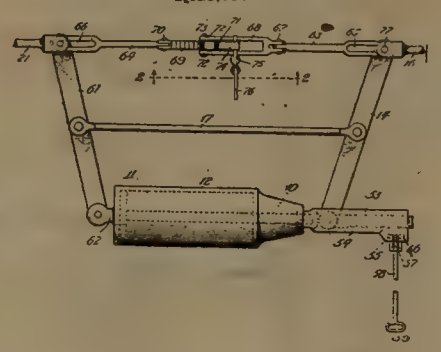
In combination, a moving coal tender having a coal receptacle, a vertical shaft journaled substantially in the center of the tender, an annular disk keyed to the shaft constituting a bottom for the receptacle, an arm plate for guiding the coal from the receptacle when the disk is rotated, one end of the arm plate constituting a bearing for the shaft, while the other end is fixed to a part of the tender, the tender having a revoluble axle, means for imparting a revoluble movement from the axle to the shaft, whereby the disk is rotated to feed the coal against the arm plate, and a manually operated mechanism for throwing the means in and out of gear with the revoluble axle.

LOCOMOTIVE SMOKE BOX.

1,023,970—B. F. Stannard, Omaha, Neb.

In combination with a horizontally disposed, cylindrical receptacle having a terminal flue-sheet providing a smoke-intake, a steam intake pipe and a discharge passageway; a horizontal partition in the receptacle to provide a lower compartment; adjacent, upright partitions disposed above and connecting the horizontal partition and the wall of the cylindrical receptacle and forming longitudinal side chambers opening upon the smoke intake with exit ports communicating with the lower compartment, and forming a separating chamber between the side chambers, the separating chamber communicating with the side chambers, the steam intake and the discharge passageway, and having an exit port and an intake port communicating with the lower compartment; and a screen mounted within the separating chamber and each side chamber, the arrangement being that the exit port of each side chamber is disposed between the screen therein and the smoke intake.

1,023,790



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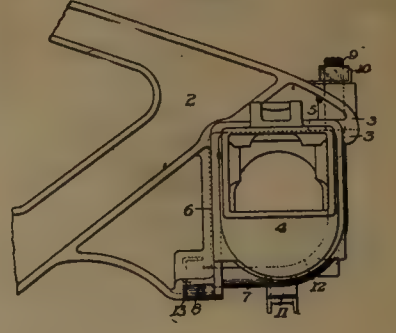


CAR HEATING SYSTEM.

In a car heating system the combination with a steam actuated air pump having an atmospheric exhaust outlet, a reservoir into which the pump is adapted to compress air, and means for supplying exhaust steam from the pump to the heating system, of a valve for controlling communication from the exhaust steam outlet of the pump to the atmosphere, a movable abutment operated according to the degree of pressure in the reservoir for actuating the valve, and means operated by the flow of exhaust steam through the valve to the atmosphere for controlling communication from the exhaust steam outlet of the pump to the heating system.

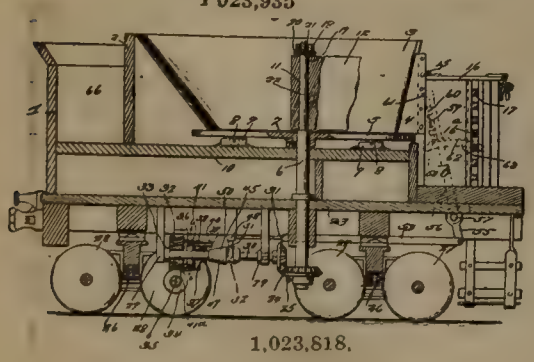
CAR COUPLING.

1,024,083—William Kelso, Pittsburgh, Pa.

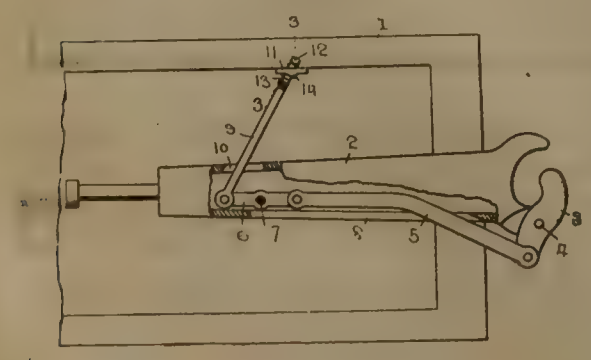
In a car coupler, the combination with a coupler head and a knuckle pivotally mounted thereon, of a pivoted catch for locking the knuckle, a supplemental lock pivotally mounted upon the catch, and a device for moving the catch to an unlocked position, the device being movable with respect to the catch and supplemental lock and being adapted to actuate each.

WANTED—Railway mechanical man, who has served as superintendent of motive power, desires to represent live manufacturer in Chicago and adjacent territory. Address S. C.—Railway Master Mechanic, 437 S. Dearborn St., Chicago.

1,023,935



1,023,818.



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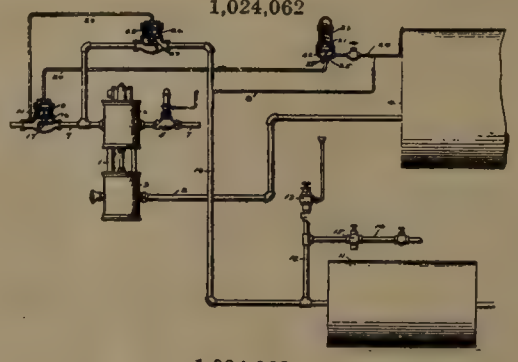

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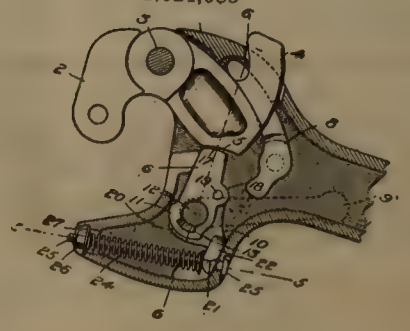

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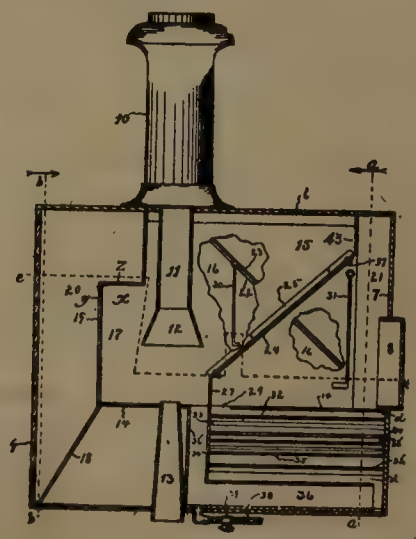

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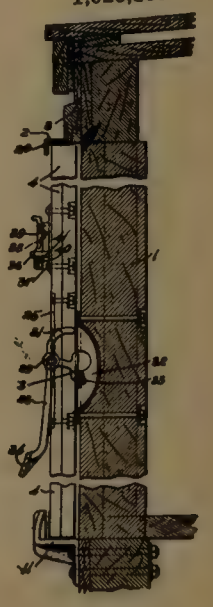

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Established 1878

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LOCOMOTIVE MANUFACTURE.

Several of the larger railways of the United States have undertaken, at some time or another, the building of locomotives in their own repair shops. Some very interesting figures have been obtained from those who have interested themselves in this method of increasing the efficiency of the shops by using their equipment for manufacturing as well as for repairing locomotives. For the past few years many of the shops have been running far below capacity while the railways operating them have purchased new power. It goes without saying, that if these shops are properly equipped, a great saving could be put into effect by keeping the machines and men busy at least to the extent of turning out the new power which must be obtained. Practically the same shop equipment which is necessary for general repair work will turn out new locomotives from tender-drawbar to pilot. It is a sad commentary on the policies of American railroading which allow the placing of outside orders for locomotives while its general repair shops are running on half time simply because deferred payments may be made to a manufacturer.

Surely it cannot be argued that the mechanical departments are not headed by men who are qualified to supervise the building of engines. The shop superintendent who admits inability to take hold of and push through a manufacturing job on locomotives, had better step down, for he cannot be qualified to handle general repairs which are sometimes of a nature more difficult than the original building.

A better standardization of construction can be obtained from home manufacture and this is one of the reasons given by the English in defense of their almost universal practice of home manufacture. Americans have given little attention to this feature, claiming that the policy of keeping money tied up in duplicate parts is an undesirable one. We believe that more money tied up in duplicate standardized parts and less money tied up in shopped engines might be in accordance with a better general policy.

The officials of an American road which has built hundreds of locomotives for its own use, have this to say in favor of their policy:

"The performance of our home built locomotives has been most satisfactory, so much so that hundreds of these engines have been taken new from the shop, exercised for several hours, put back in the roundhouse and minor defects corrected. The engines have then gone out and given entirely satisfactory service without other attention until it was time to wash boilers. *This is an advantage in itself over the engines we have bought.*

"Several years prior to the time the Interstate Commerce Commission laid down a definite plan for railway accounting, it was our practice to charge a certain percent against all new construction to make good the items of expense, such as depreciation of tools and buildings. The result was that locomotive repairs would be credited with this item. During the years in question many thousands of dollars charged to new locomotives went towards relieving the cost of car and locomotive repairs, and yet after making these deductions or charging these items to the new equipment, we still had a very large surplus in favor of building the new power.

"At the time we were preparing for the state a physical valuation of our properties, one of the questions most in controversy with the state engineers was the cost of equipment built at our

shops. We furnished them in our physical valuation, the actual cost of locomotives built at our shops and of those purchased. In the case of those built in our shops, the state engineers found that our prices averaged from ten to twelve per cent lower than the manufacturers' prices, and they insisted that we boost the prices on our new power from ten to fifteen per cent over what they appeared on our books."

An important consideration in this connection is this: Were it not for the fact that the shop machinery can be used a great deal in manufacturing, there are many tools essential to efficient repair work which would not be obtained for repair work only. This is true especially in heavy forging and casting work.

One of the officials above quoted makes the following positive and significent statement:

"If the cost of the equipment built in our own shops was compared with what it would have cost if purchased, the tools, machinery and ground at our shops have been paid for from the profits of this policy. In other words, our entire shop plant has not cost our company one cent if the profits accruing from the manufacturing work were credited to the plant."

CAR DOORS.

From the time of the first box car, trouble with doors has been in evidence. When doors were made weather tight their action was poor; when they were made to slide easily they were lost off the cars in numbers; when an attempt was made to prevent their loss they cramped in sliding. Recently a new trouble has developed. With the advent of the very large automobile car it was found necessary to make the door openings wider. One road has just finished the home construction of a large order of cars having door openings 10 feet 6 inches wide. This large door opening would have weakened the car structurally were it not for the fact that means were taken to offset this evil by the construction of the door. Two designs of door were used. One necessitated the use of an auxiliary strengthening post, while the other was found to be in the construction of its framing fully strong enough to allow the wide opening without weakening the car. Better still it has been found that the latter door is more nearly weather proof than its predecessors; that it does not cramp in sliding; that its fastenings are such as to make its loss impossible unless the side of the car is lost with it.

To the master car builder and the car foreman these are unusual and interesting features in one combination. It seems, however, of prime importance that any door specified should have them all, regardless of other advantages. Not only is it aggravating to find it necessary, at frequent intervals, to pick up on the right of way lost doors by the carload as the mechanical officials of one road report doing, but cars equipped with doors of such tendency are a source of much worry. On double track the loss of a door often means the derailment of an opposite bound train. Hence, an element of danger enters the case with the use of the door which may become separated from the car.

THE BIG FELLOWS.

There are some sixteen or seventeen thousand railway officials in this country, ranging from president down to roadmaster and foreman. These officials control and operate the biggest and most vital single industry, outside of agriculture, in this country; that of transportation. It is doubtful if any single group of officials has as many burdens and responsibilities. Time is one of the essential elements of railway operation, for on the unimpeded transference of people and commodities, depends the welfare of the country and its industries. It is the operating department that feels this the most, of course; but the operating department must depend on the mechanical department to keep the rolling stock in such condition that will enable it to keep the stream of traffic constantly moving.

Then there is the public to be taken into consideration. The average man, because he has had a great deal of experience in riding on trains, feels fully competent to give advice regarding the equipment and operation of the road. One day while talking with a man on a station platform, he remarked: "They've got a thing on these engines now that saves an awful lot of coal." "That so, what is it?" "I don't know just what it is but anyway they say it saves 50 per cent of the coal. Now, if some of the other roads around here would use that they would save a lot of money."

But in spite of his troubles and responsibilities there is no more courteous official in the country today than the average railway official. He is always ready to see anyone who has a legitimate reason for seeing him; he is always ready to give a hearing and a trial to any device which gives an indication of being an improvement on those performing the same duties on his road; he is always ready to give his brother railroad man any information which will aid him in his work. If you will notice a gathering of railway men, you will notice that as a rule they are big men, strong men, physically, they are not small "two by four" men. They handle the varying problems of an industry upon which the whole country is dependent, with forcefulness and strength. Railway officials, and we feel particularly those of the mechanical department, are well worthy of the title of "The Big Fellows."

OIL BURNING EQUIPMENT.

The past ten or twelve years have witnessed a marked extension of the use of fuel oil on American railways, particularly on the Western roads. Previous to 1900 but little had been done towards the adoption of oil as a locomotive fuel, notwithstanding the fact that America was by far the heaviest producer of crude oil. At present it is estimated that there are at least 5,000 engines out of a total of 60,000 in this country, equipped for burning oil, the greater percentage of these being west of the Mississippi river. It of course is not to be expected that the use of oil will in any sense become universal, but it has been shown that on those roads which are in close proximity to the oil fields, it can be used economically. It is also being used in certain localities to lessen the dangers of forest fires. The Southern Pacific is the heaviest user of oil, having 1,239 oil burners in service on the Pacific system. This system is naturally so situated as to be able to use oil to the best advantage, its center of gravity, so to speak, being located in the California oil fields. The Santa Fe is also a heavy user of oil, having nearly nine hundred engines in service as oil burners. The methods employed by these and other roads with respect to

oil burning equipment are published elsewhere in this issue, together with the practices of one or two foreign roads.

The universal practice in this country is to locate the burner at the front end of the firebox and the majority of roads do not use the brick arch in this connection, the Rock Island being a notable exception. It will be noted that on the Moscow-Kazan Ry. of Russia that this process is reversed, the brick arch being used, with the burner located at the rear end. Placing the burner at the rear end has been tried on a number of American roads but the results have not been very satisfactory. Although three different varieties of burners are in common use in this country, they are all of the same general type and differ considerably from the burner used on the Moscow-Kazan Ry. The use of the oil-burner has been satisfactory in Russia but is limited on account of the high price of oil, its present cost being over a dollar per barrel.

As to the effect of oil burning on sheets and flues, there seems to be a lack of definite information, the opinion seeming to pervail that it is somewhat harder than coal. Mr. Small of the Southern Pacific states, however, that with a properly arranged firebox, no bad results are experienced and this statement should carry weight, inasmuch as the Southern Pacific has had a wide and varied experience. The Chicago, Milwaukee & St. Paul reports that maintenance of oil burning engines costs about 40 per cent more than coal burners and repair on flue and seams average 25 per cent more. Trouble has been experienced mainly with back flue sheets and tubes and the breaking of staybolts. These increased costs have been about in the same ratio as those on the San Antonio & Aransas Pass. This is a subject, however, which should bear a closer investigation, for if the cost of oil burning is not being added to by the decreased life of fireboxes and sheets, then those roads which have reported such as the case, have engines which are not equipped for burning oil in the most efficient manner. The Santa Fe although a heavy user of oil, reports having no definite information, although officials of this road have stated that they thought there were bad effects. It is surprising that a road which has done so much work in the line of tests and investigation, has not touched this subject, and we think that it is a subject well worthy of the applied attention of some road in the near future. Of course the quality of the oil itself may cause some trouble; the Tehuantepec National has recently commenced using a thick heavy Mexican oil containing 3.44 per cent of sulphur and it will be interesting to know if it will still continue to have "no trouble whatever."

As oil from many different fields is used, it varies considerably in characteristics, calorific values run from 16,740 B. t. u. to 19,000 B. t. u. and flash points show a wider variation, running from 83° F. on the Santa Fe to 250° F. on the Southern Pacific. The few figures available on the cost per ton-mile show quite a variation, due largely to the physical situation of the road, but these are not enough to base an opinion on. Three roads report an increase in engine tonnage ranging from 3 to 25 per cent.

Most of the roads using oil expect to extend its use, but the time is coming when they cannot do so economically, as the price of oil is going up, due to the increasing use of crude oil and its distillates, throughout the country. The Rock Island is already uncertain regarding the extension of its use for this reason. However its use is at present being extended and will continue for some time to come.

The Big Fellows

By Berton Braley

Copyrighted 1912, By William E. Magraw

Dedicated to the 1911-12 Officers and Executive Committees of the M. C. B. & A. R. M. M. Ass'ns.

Up from the crowd and the press they rose,
  Up from the common soil,
Taking and giving their share of blows,
  Knowing the sweat and toil;
They have played the game as the game is played
  In jumper and overalls,
They have hardened their hands at a workman's trade,
And risen to power, grade by grade,
  From within the grim shop walls!

Strong men are these who have won their way,
  By magic of thews and brain,
From 'prentice jobs with 'prentice pay
To masters of men who hold their sway
  Where the railroad rulers reign;
And some are grizzled and stern and gray
With the strain and stress of the life-long fray,
  And some are smiling and young;
But they all are part of the mighty scheme
Of clanging shops and of hissing steam,

Of engines roaring and lights that gleam
And the shining rails far-flung!

Chiefs who have struggled heart and soul
For the glory of steam and steel and coal
These are the men on the honor roll;
Bentley, born under English skies
And learning his trade there, too,
Who looked to our land with eager eyes
A land that was rich and new;
He came, determined to work and rise,
And power has been his hard-earned prize,
For he put his vision through!
Nothing could keep his spirit pent,
The Master Mechanics' President!

And then there's Alex Stewart, once with the old U. P.,
Southern Railway Motive Boss and head of the shops is he,
Chief of the Master Builders scattered from Sea to Sea.

D. F. Crawford started in
As a 'prentice, 'mid the din
Of the Pennsy shop.
Ground his teeth, stuck out his chin,
Simply set his mind to win,
Wouldn't pause or stop!
Now the engine wheels that turn
And the valves that pop,
Every one is his concern—
He is at the top!

Rumney of the Rock Island, climbed as the rest have climbed,
By force of his grit and pluck and brains and energy well timed,
And D. R. MacBain of the Lake Shore Line is one of the men who came
From the rank and file to a place worth while of power and pay and fame,
For he did his trick at the fire box door when the old wood-burners ran,
And he tackled each job that came to him like a first-class railroad man,
Wiper and fireman and engineer, steadily hour by hour,
He made his way to the place he holds as Boss of the Motive Power!
And there is Angus Sinclair, the Scot, and a braw brave lad is he
Who started his work as a railroad man 'ere ever he crossed the sea,
Fireman, chemist and engineer, publisher, writer too,
There isn't a thing in the railroad craft that Angus Sinclair can't do!

Fuller—Charles E.—of the old U. P.—was a draftsman at 17;
Then he took a whirl at the shops to learn each part of the big machine.
He was bound to creep to the top of the heap and nothing could block his way,

He was Motive Chief for the Erie line and went to the
C. and A.,
And thence he stepped to the old U. P., where he holds
his place today!

Power Chief of the I. C. line
Is a big man's place for fair.
M. K. Barnum fills that job,
With its burden of work and care,
For he pushed his way from a 'prentice bench
To a superintendent's chair!

Builder of cars is old John Lentz
For the Lehigh Valley Road;
Driven on by a will intense,
By faith and labor and confidence,
Up the ladder he strode,
Till now, by dint of his own stern code,
He builds the cars for the Lehigh Road.

Joe Taylor works and toils and sweats
(For he's the secretary),
But still the same results he gets—
Committees never vary.
They all seem careless, slack and slow,
Reports they give him never.
Committees come, committees go,
But Joe goes on forever.

Theodore Curtis chases the smoke,
Chases the smoke away,
Fighting Chicago's murky cloak
Is a man's size job and never a joke
And never a bit of play.
But he learned his trade in the railroad game
Which isn't lazy and isn't tame,
But a lively and hard-fought fray,
So Theodore Curtis chases the smoke,
Chases the smoke away!

Here's Wildin—George—who has hoed his row
From San Francisco to Mexico,
Sante Fe and the C. and A., Erie and Lehigh Valley,
yes,
And the old Plant system too, I guess;
New York, New Haven has him now,
For he carries the goods in his head—that's how!

But the story's the same from the very start;
They've planned and worked with head and heart;
C. A. Seley—Rock Island Lines—who started 33 years
ago,
F. F. Gaines of the Georgia Central; J. F. Walsh of
the C. and O.;
Pratt of the great Northwestern line, and Harris (J.
D.) of the B. and O.
Men who were bound to get ahead and who wouldn't
falter when Fate cried "Whoa!"
Henry Bartlett, Mechanic in Chief for every mile of
the B. and M.,

A Harvard man who toiled in the ranks but who rose
to the goal he sought from them;
Brazier—a car repairer once—in the days when cars
were a lighter flock,
And now on the New York Central lines where he is
Boss of the Rolling Stock;
C. A. Schroyer (Northwestern Lines), Doctor in Chief
to each crippled car;
Alex Kearney of Roanoke, who started humbly but
traveled far,
This is the sort of Railroad men the Master Mechanics and Builders are!

Fate couldn't throw any scare in them,
Not with her Ugliest Frown,
What with the Do and the Dare in them
Nothing could hammer them down!
Trampling traditions gone mouldering,
Planning new methods instead,
Through all the crowd they came shouldering, thrusting their way to the head!

Where the limited's swaying and thundering
And gone in a flash and a flare,
Leaving us gaping and wondering
In the rush of the dust-laden air;
Where the freight trains are groaning and clattering
As they toil over valley and grade,
Where the hammers are beating and battering,
These masters have studied their trade.

Not by a Luck that is glorious
Came all these men to their own,
But by a Service laborious
Through all the years that have flown!
Wherever a track cuts the scenery
There's work for these workers to do,
Masters of Men and Machinery—
Making the Dream come True!

YOUR RESPONSIBILITY.

J. F. Long.

If a railroad company bought and installed every known safety appliance that the inventive mind could suggest, it would yet be necessary to depend upon human agency to render the use of it as well as maintain its high efficiency.

Too often when an accident occurs we are apt to see where the other fellow has failed to do that which he should have done, and lose sight of the thing we are responsible for, not to man necessarily but to the Supreme Ruler, to whom our final report is made. If this be true, should we not consider carefully our full responsibility in preventing accidents both direct and indirect? A suggestion, a word of caution, a little action, etc., all are in our power.

Do not try to fool yourself by simply sitting idle and making no effort, then when a serious accident occurs say, "It was due to a defective appliance, and I can prove it," for your conscience will come back at you and say, "you knew the appliance was defective, what effort did you make to correct it?" You know how the appliance and its defective condition should have been handled, and you can only say over and over again, "I wish I had done my duty."—Illinois Central Employees' Magazine.

Man is judged not by his words, but by his deeds.
He lives best that does not follow, but who leads.
Let those who lead watch that he who follows
Be lead to hilltops, not to hollows.

—F. W. Brazier.

OFFICERS OF THE MASTER CAR BUILDERS' ASS'N.

Alexander Stewart, President.

Mr. Stewart entered railway service with the Union Pacific as a machinist apprentice. After serving his apprenticeship, he worked as a machinist, machine foreman, general foreman, general division foreman and master mechanic, leaving the service of the Union Pacific in 1903 to accept a position as division master mechanic with the

Alex. Stewart, Pres., M. C. B. Assn.

Southern Railway at Knoxville, Tenn. Four months later he was promoted to general master mechanic of the Western district of that road. On the resignation of Samuel Higgins, April 1, 1904, Mr. Stewart was appointed mechanical superintendent, and two years later, April, 1906, he was made general superintendent motive power and equipment.

Chas. E. Fuller, Vice-President.

Mr. Fuller was born in Terre Haute, Indiana, in October, 1863. He started his railroad career as draftsman with the Vandalia Railroad at Terre Haute in 1880; he served three years in the drawing room, the later part of this period as chief draftsman. He then entered the Vandalia shops as apprentice and was employed in these shops six

Chas. E. Fuller, V. P., M. C. B. Assn.

years as machinist apprentice, machinist and foreman. In 1889 he was appointed general foreman of the Hornell shops of the Erie Railroad. In 1890 he was made master mechanic of the New York division of the Erie Railroad. In 1892 he was appointed superintendent motive power of the Central Vermont Railroad with office at St. Albans, Vt. In September, 1901, he went to the Erie Railroad at Meadville, Pa., as assistant mechanical superintendent and served in that capacity until August, 1903. From August, 1903, until February, 1908, he was superintendent of motive power of the Chicago & Alton at Bloomington ,Ill. February, 1908, Mr. Fuller went to the Union Pacific as assistant superintendent motive power and July, 1908, was appointed superintendent motive power. July, 1910, he was appointed assistant general manager, which position he still holds.

D. F. Crawford, Vice-President.

(See biographical sketch under "Officers of the American Railway Master Mechanics' Ass'n.)

Morgan K. Barnum, Vice-President.

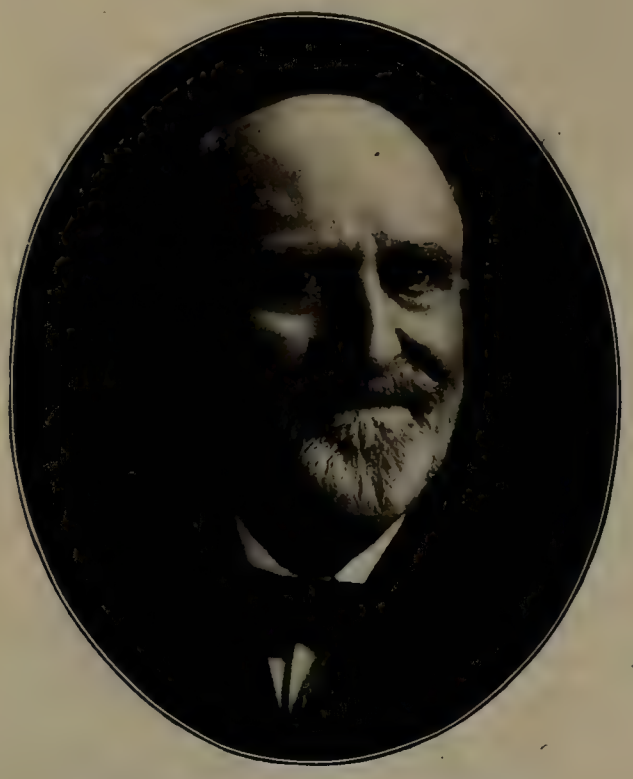
Mr. Barnum was born April 6, 1861. He was graduated from Syracuse University in 1884 with the degree of bachelor of arts, and later had the degree of master of arts conferred upon him. He entered the service of the New York, Lake Erie & Western, now the Erie, at Susque-

Morgan K. Barnum, V. P., M. C. B. Assn.

hanna, Pa., as a special apprentice. He was a machinist, mechanical inspector and general foreman of the same road at Salamanca, N. Y., also general foreman of the Louisville & Nashville shops at New Decatur, Ala.; assistant master mechanic of the Atchison, Topeka & Santa Fe at Argentine, Kan.; superintendent of the Union Pacific shops at Cheyenne, Wyo., and later district foreman of the same road at North Platte, Neb., and division master mechanic at Omaha. He was then appointed assistant mechanical superintendent of the Southern Railway, and in February, 1903, was appointed superintendent of motive power of the Chicago, Rock Island & Pacific. In April, 1904, he was made mechanical expert of the Chicago, Burlington & Quincy, and in 1907 was made general inspector of machinery and equipment of that road, reporting directly to the vice-president. In the spring of 1910 he was appointed general superintendent motive power of the Illinois Central, the Indianapolis Southern and the Yazoo & Mississippi Valley.

John Lentz, Treasurer.

Mr. Lentz was born October 29, 1847, at Mauch Chunk, Pa. He entered railway work in 1865. Since that time and until 1881 he has been storekeeper, clerk, operator and assistant to master car builder, and acting master car builder on the Lehigh Valley R.R. From 1881 to 1889 he was master car builder; from 1889 to 1897 he was superintendent of the car department; from 1897 to 1900 he was assistant superintendent of motive power; from January, 1900, to date



John Lentz, Treas., M. C. B. Assn.

he has been master car builder. All of Mr. Lentz's service has been on the Lehigh Valley. He was elected 3rd vice-president of the Master Car Builders' Ass'n in 1887. In 1890 he was elected 2nd vice-president. In 1893 he was 1st vice-president. He was president of the association in 1894 and 1895.

Jos. W. Taylor, Secretary.

Mr. Taylor entered railway service in 1876 as clerk in the freight office at Saltsburg, on the West Pennsylvania division of the Pennsylvania Railroad, and was later transferred to Johnstown, Pa., on the main line of the Pennsylvania Railroad. In July, 1880, he entered the office of Mr. F. M. Wilder, superintendent of motive power of the New York, Lake Erie & Western Ry. and served in various capacities under Mr. Wilder and under the latter's successor, Mr. R. H. Soule, during their respective terms of office. In 1887 Mr. Taylor was selected as chief clerk in the office of Mr. R. H. Soule, who was then the general manager of the New York & Western R. R. Upon Mr. Soule's resignation Mr. Taylor accepted a position in the office of Mr. S. M. Felton, when the latter was first vice-president of the New York, Lake Erie & Western. He was later secretary to Mr. A. Hegewisch, president of the United States Rolling Stock Co., at New York City. Mr. Taylor occupied this position for a short time, when he resigned to accept the position of secretary of the Chicago & Calumet Terminal Ry. Co. at Chicago, now a part of the Chicago Terminal Transfer R. R. Co. On January 15, 1891, he took service with John W. Cloud, the western representative of the Westinghouse Air Brake Co., and secretary of the Master Car Builders' Association, and later also secretary of the American Railway Master Mechanics' Association. Mr. Taylor remained continuously in this service until his election to the secretaryship of the two associations, at the Old Point comfort conventions in 1899, to fill the vacancy occasioned by Mr. Cloud's resignation.

Jos. W. Taylor, Sec., M. C. B. and A. R. M. M. Assns.

EXECUTIVE COMMITTEE, MASTER CAR BUILDERS' ASSOCIATION.

J. D. Harris, Member Exec. Committee, M. C. B. Assn.

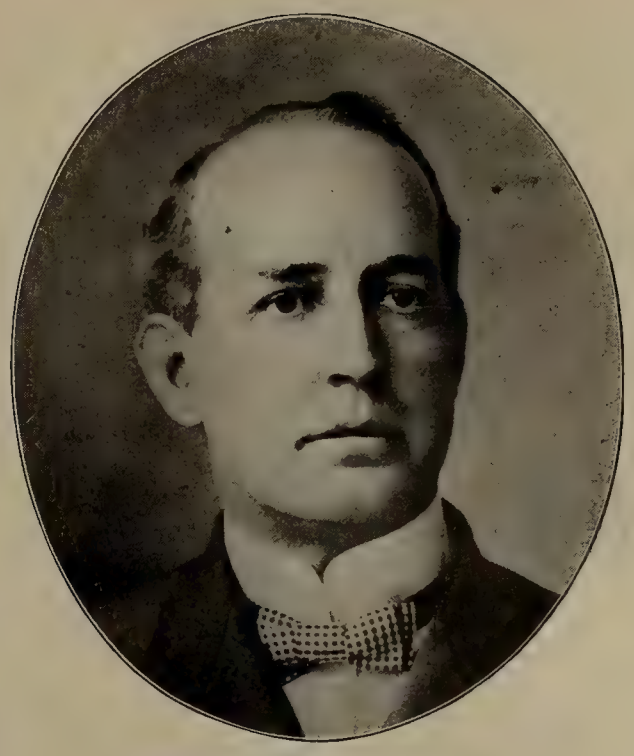
Henry Bartlett.

Mr. Bartlett was born March 29, 1864, at Lowell, Mass. He is a graduate of Harvard University. He entered railway service in 1886, since which he has been, consecutively, 1886 to 1889, apprentice in the shops of the Pennsylvania R. R., at Altoona, Pa.; 1889 to 1891, assistant road foreman of engines, Pittsburgh and Middle divisions, Pennsylvania R. R., and Maryland division, Philadelphia, Wilmington & Baltimore R. R.; 1891 to Jan. 1, 1895, assistant superintendent motive power, Pennsylvania R. R., at Altoona, Pa.; Jan. 1, 1895, to Jan. 1, 1907, superintendent motive power, Boston & Maine R. R.; Jan. 1, 1907, to date, general mechanical superintendent, Boston & Maine R. R.

C. A. Seley.

(For biographical sketch see "Executive Committee, American Railway Master Mechanics' Assn.")

Henry Bartlett, Member Exec. Committee, M. C. B. Assn.



C. A. Schroyer, Member Exec. Committee, M. C. B. Assn.

F. W. Brazier.

Mr. Brazier was born in Boston, Mass. He entered railroad service as car repairer, served as foreman, wreck master and general foreman on the Fitchburg Railroad; then as superintendent of the New York Dairy Refrigerator Line, Chicago, Ill.; then general foreman and superintendent car department of the Illinois Central R. R.; then to the New York Central & Hudson River R. R. as superintendent of rolling stock. This position he has held for the past twelve years.

F. W. Brazier, Member Exec. Committee, M. C. B. Assn.

C. A. Schroyer.

Mr. Schroyer was born in Milton, Pa., October 14, 1853. He entered railway service in the Renova shops of the Pennsylvania R. R. in 1877. He has subsequently been associated with the Ohio Falls Car Works and the J. M. & I. R. R. at Jeffersonville and Indianapolis, Ind. He was appointed assistant superintendent, car department, of the Chicago & North Western Ry. in 1886, and was promoted to superintendent of the car department, his present position, one year later. He was president of the Master Car Builders' Assn. in 1899 and 1900.

Alex. Kearney, Member Exec. Committee, M. C. B. Assn.

Alexander Kearney.

Mr. Kearney was born at Washington, D. C., Oct. 24, 1869. He was educated at Georgetown University. He entered railway service in 1888 as an apprentice for the Pennsylvania R. R. Since that time and until 1902 he served the Pennsylvania as assistant road foreman of engines, assistant engineer of motive power, master mechanic, and superintendent of motive power. From April, 1905, to date he has been assistant superintendent of motive power of the Norfolk & Western.

OFFICERS OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

Harry T. Bentley, President.

Mr. Bentley was born June 4, 1862. He was educated at Dulwich College. He entered railway service 1877 with the London and Northwestern Ry., of England, since which he has been consecutively to 1887, apprentice,. machinist, and 1887 to 1892, foreman engine house of the same road, at Chester, England. 1892 to 1895 he was machinist of Chicago shops and round house foreman at Boone, Ia., Chicago & Northwestern Ry.: 1895 to 1898 he was foreman at Belle

H. T. Bentley, Pres., A. R. M. M. Assn.

Plaine, Ia.; 1898 (for seven months), general foreman at Clinton, Ia.; April 1 to December 30, 1899, master mechanic Madison division; from January 1, 1900, to August 31, 1902, master mechanic of Iowa division; September 1, 1902, to date, assistant superintendent motive power and machinery, same road.

D. F. Crawford, Vice-President.

Mr. Crawford was born December 4, 1865. He was educated at Pennsylvania Military Academy. He entered railway service in 1885 as apprentice at the Altoona shops of the Pennsylvania R. R., and has been with this system continuously since. From 1889 to 1892 he was inspector of the test department; from 1892 to 1895, assistant master mechanic at Fort Wayne, Ind.; from 1895 to 1899, assistant superintendent of motive power; from 1899 to 1903, superintendent of motive power; from 1903 to date he has been general superintendent of motive power of the Pennsylvania Lines west of Pittsburgh.

D. F. Crawford, V. P., A. R. M. M. and M. C. B. Assns.

T. Rumney, Vice-President.

Mr. Rumney was employed with the Erie Railroad for ten years, holding positions as foreman, general inspector of machinery, master mechanic, assistant mechanical superintendent, mechanical superintendent and general mechanical superintendent. In January, 1912, he left the service of the Erie Railroad to become assistant second vice-president in charge of the mechanical department of the Chicago, Rock Island & Pacific Ry.

D. R. MacBain, Vice-President.

Mr. MacBain was born at Kingston Heights, Ont., October 23, 1861. He entered the service of the old Canada Southern Railway as machinist apprentice in 1876. In May, 1878, he gave up the idea of becoming a machinist and started firing locomotives, many of which were wood-burners at the time. In 1882 he was promoted to locomotive engineer, and in 1890 was promoted to position of traveling engineer, covering the district embraced by the old Canada Southern Railway, now the Canada division of the Michigan Central. July 1, 1900, he was promoted to master mechanic of the Western division, with office at Michigan City, Ind. April 1, 1901, he took the position of master mechanic at St. Thomas, Ont. January 1, 1902, he was promoted to the position of master mechanic at Jackson, Mich. July 23, 1906, he was promoted to the position of assistant super-

D. R. MacBain, V. P., A. R. M. M. Assn.

T. Rumney, V. P., A. R. M. M. Assn.

intendent of motive power of the Michigan Central, with office at Detroit, Mich. April 1, 1908, he was transferred to the New York Central & Hudson River R. R., with office at Albany, N. Y., in the same capacity. May 15, 1910, appointed superintendent of motive power of the L. S. & M. S. Ry., L. E. & W. R. R. and C. I. & S. R. R., with office at Cleveland, Ohio.

Angus Sinclair, Treasurer.

Mr. Sinclair was born in Scotland. He had a common school education, and entered railway service as a telegraph clerk on Scottish North Eastern Railway. He received mechanical training in the repair shops of same railway. He came to United States in 1873 and went to work on the Erie Railroad. Later he worked in the Brooks Locomotive works. While serving as a locomotive engineer of the Chicago, Clinton & Western R. R., he attended chemistry classes of the Iowa State University. He was appointed chemist of the Burlington, Cedar Rapids & Northern Railway, and was a locomotive engineer and engine house fore-

Angus Sinclair, Treas., A. R. M. M. Assn.

man of the same road. While so engaged, he wrote a book called, "Locomotive Engine Running and Management." He left railway service in 1883 to join the editorial staff of the American Machinist, and has been engaged in that class of work ever since. In 1892 he organized the Angus Sinclair Company to engage in publishing Railway and Locomotive Engineering. He was secretary American Railway Master Mechanics' Association, 1887 to 1896. Treasurer, American Railway Master Mechanics' Association 1900 to date. He had a degree of Doctor of Engineering from Purdue University in 1908.

Jos. W. Taylor, Secretary.

(See biographical sketch under "Officers of the Master Car Builders' Association.")

EXECUTIVE COMMITTEE, A. R. M. M. ASSN.

Theodore H. Curtis.

Mr. Curtis was born in 1886 at Terre Haute, Ind. He entered railway service in 1886 as chief draftsman of the Cincinnati, Indianapolis, St. Louis & Chicago Ry. at Cleveland, O. He was made mechanical engineer of the Erie R. R. in 1899. He became mechanical engineer of the Louisville & Nashville R. R. in 1901. He was promoted to the position of superintendent of

Theodore Curtis, Member Exec. Committee, A. R. M. M. Assn.

machinery of the same road in 1903. He recently left that position and accepted the appointment of mechanical engineer to the electrification committee of the Chicago Association of Commerce.

Geo. W. Wildin.

Mr. Wildin was born at Decatur, Ill., February 28, 1870. He entered the Kansas State Agricultural College in September, 1887, completing both the mechanical and civil engineering courses, and graduated with the degree of Bachelor of Science, June 9, 1892. He entered the service of the Atchison, Topeka & Santa Fe Ry. in July, 1892, as mechanical draftsman, and has filled the following positions with various railroads and private concerns: draftsman, car repairer, machinist and locomotive fireman, A., T. & S. F. Ry.; Columbian guard, World's Fair, Chicago; locomotive engineer, Mexican Central R. R.; superintendent of shops, The Aer Motor Co., Chicago; locomotive engineer, Chicago & Alton R. R.; machinist, inspector and mechanical engineer, The Plant System of Railways (now a part of the Atlantic Coast Line R. R.), Savannah, Ga.; mechanical engineer, C. R. R. of N. J.; assistant mechanical superintendent and mechanical superintendent, Erie R. R.; assistant superintendent motive power, Lehigh Valley R. R.; mechanical superintend-

Geo. W. Wildin, Member Exec. Committee, A. R. M. M. Assn.

ent, the New York, New Haven & Hartford R. R.; which position he now holds.

F. F. Gaines.

Mr. Gaines was born March 28, 1871, at Hawley, Pa. He graduated from Cornell in mechanical engineering and started railway work in June, 1890, as a special apprentice with the Erie & Wyoming Ry. From 1895 to 1904 he was continuously with the Lehigh Valley R. R. as draftsman, engineer of tests, chief draftsman, mechanical engineer and master mechanic. He was appointed mechanical engineer of the Philadelphia & Read-

F. F. Gaines, Member Exec. Committee, A. R. M. M. Assn.

ing in 1904 and became superintendent of motive power for the Central of Georgia (his present position) in 1906. While Mr. Gaines' title with the Philadelphia & Reading was mechanical engineer, his duties were those of assistant superintendent of motive power.

J. F. Walsh, Member Exec. Committee, A. R. M. M. Assn.

Chas. A. Seley.

Mr. Seley was born Dec. 26, 1856, at Wapella, Ill. He entered railway service in 1879 and until 1881 was a draftsman for the St. Paul, Minneapolis & Manitoba Ry. From 1881 to 1886

Chas. A. Seley, Member Exec. Committee, A. R. M. M. Assn.

he was engaged in outside work. From 1886 to 1888 he was chief draftsman of the St. Paul & Duluth R. R.; 1888 to 1892, with the Great Northern Ry.; 1892 to 1895, in railway supply business; 1895 to 1899, chief draftsman, Chicago Great Western R. R.; 1899 to 1902, mechanical engineer, Norfolk & Western Ry. From May 1902 to date he has been mechanical engineer of the Chicago, Rock Island & Pacific Ry.

J. F. Walsh.

Mr. Walsh was born in Cleveland, Ohio, March 29, 1857. He was educated at the parochial school and Spencerian Business

E. W. Pratt, Member Exec. Committee, A. R. M. M. Assn.

College. At the latter place he gave special attention to mechanical drawing, etc. He entered railway service as a machinist apprentice in the old "Bee Line" shops at Cleveland, Ohio, in September, 1871. He afterwards fired a locomotive. He was promoted to the position of locomotive engineer in November, 1879. He was a roundhouse foreman from 1884 to 1890, and locomotive engineer from 1890 to 1892. He was appointed mechanical expert for the Galena Signal Oil Co. in 1892. He has been general superintendent of motive power of the Chesapeake & Ohio Ry. from 1902 to date.

Edward W. Pratt.

Mr. Pratt was born at Fort Atkinson, Wis., June 2, 1869, was named for his uncle, the late Dr. Edward H. Williams, of the Baldwin Locomotive Works. Previous to attending college and during his university vacations he followed field work in civil engineering on the Chicago & North-Western and the Elgin, Joliet & Eastern, the latter during construction. After graduating from the mechanical engineering course at Lehigh University, he was for a short time engaged in the manufacture of varnish and lubricating oils in San Francisco; designing engineer for the Western Electric Co., Chicago, 1890-1891; general superintendent Chicago Hardware Co., 1891-1892. Having studied telegraphy as a boy under his father, at that time one of the oldest employes of the Chicago & North-Western Railway, he re-entered the employ of this company in 1892 as general air brake inspector, first taking a course of practical work in the shops and later having charge of the instruction car until 1899. Roundhouse foreman at Chicago 1900; general foreman, Ashland, Wis., 1901; master mechanic, Mason City, 1902; master mechanic Lines West of Missouri River, Misouri Valley, Ia., 1903 to 1908; assistant superintendent motive power and machinery since January, 1909.

Oil Burning Locomotives

The United States produces by far the largest amount of crude oil. In 1910 the production in this country was 209,556,048 barrels which was nearly two-thirds of the production of the world for that year. Russia came next with 70,336,574 barrels; Galicia and the Dutch East Indies following with 12,673,688 barrels and 11,030,620 barrels respectively, while our neighbors Mexico and Canada produced respectively 3,332,807 barrels and 315,895 barrels. California leads the states in the amount produced, with Oklahoma closely following and with Illinois, West Virginia, Ohio and Texas next in order. It is therefore not surprising that the use of oil as a locomotive fuel has been extended rapidly in the United States during the past five or ten years. During 1910 the railroads consumed 24,586,108 barrels of oil, of which 768,762 barrels were used for fuel other than for locomotives. The consumption for this and previous years is shown in the table herewith, from the government reports and which indicates an increase of 23.3 per cent in 1910 over 1909.

Year.	Length of line operated by the use of fuel oil.	Quantity of fuel oil consumed by railroads.	Total mileage made by oil-burning engines.	Average number of miles per barrel of oil consumed.
	Miles.	*Barrels.*	*Miles.*	*Miles.*
1906		15,577,677		
1907	13,573	18,855,002	74,079,726	3.93
1908	15,474	16,889,070	64,279,509	3.81
1909	17,676	19,939,394	72,918,118	3.66
1910	22,709	24,586,108	89,107,883	3.74

The increasing use of oil is due to a number of reasons. Its adoption by roads in California, Texas, Oklahoma and adjacent territory, has been more universal than in other sections, because of their close proximity to the oil fields, enabling oil to be transported at a lower cost than coal and where it has been shown that, at the present prices, it can be used more efficiently than coal. The supply of oil is less liable to fluctuation by reason of strikes and car shortages and does not suffer losses by evaporation and theft in transit and storage. The cost of handling oil from storage to engine tenders is less than for coal and inasmuch as a pound of oil contains approximately 25% more heating value than a pound of coal, the capacity of the tender in heating units is greater, making longer runs possible. Longer runs are also possible because of the fact that the fireman is relieved of heavy physical exertion. As cinders are eliminated travel is made pleasanter for passengers and it is unnecessary to cut out engines for fire cleaning. The percentage of engine failures is reduced and in general there is an increase in efficiency.

The trans-continental roads in the Northwest and Canada constitute another group which have adopted oil burners for certain districts, primarily in order to eliminate the danger from forest fires. This has been done not only from the standpoint of conservation and public policy, but also to protect roadbeds from landslides which so often are the result of deforestization in a mountainous country. The Canadian Pacific is now equipping its engines in British Columbia with oil burners, for this reason. A number of roads in the East, such as the New York Central and the Delaware & Hudson, are also equipped with oil-burners through certain limited districts in order to eliminate the danger of forest fires.

Oil-burners have been installed on practically all of the various types and classes of engines and on both wide and narrow fire-boxes. Although some locomotives are supplied with tenders consisting of a cylindrical tank, especially built for the use of oil, on the majority of locomotives the oil tank has been made to fit into the coal space on the regular tender. No changes are made in the fire-box with the exception of lining the bottom and the lower walls with fire-brick as shown in figure 1. The general practice is to insert the burner or atomizer at the front end of the fire-box; that is, pointing toward the fire-door end. A number of different forms of burners are in use in this country, all of which are probably more or less efficient. However, the construction and lining of the fire-box, together with the proper education of the firemen in the proper handling of fuel oil have a more direct bearing upon the efficiency obtained. The burner which, perhaps, is the most widely used is the Von Boden-Ingles, a cross-section of which is shown in figure 2. This burner, it will be seen, consists essentially of an upper and lower passageway, each in the form of a slot having a width of about 3½ inches. The oil makes its way through the upper passageway and upon emerging, falls upon a projecting lip, across which the steam blows from the lower passageway. The Booth burner, used on the Santa Fe and shown in figure 3, is similar to the Von Boden-Ingles, except that the oil is forced straight out and is not distributed

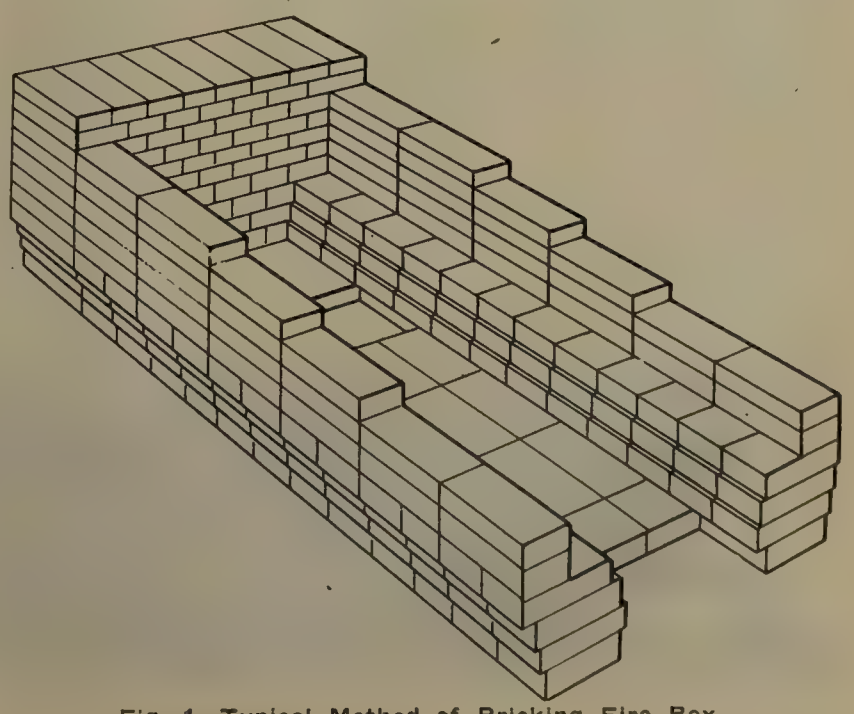


Fig. 1—Typical Method of Bricking Fire Box.

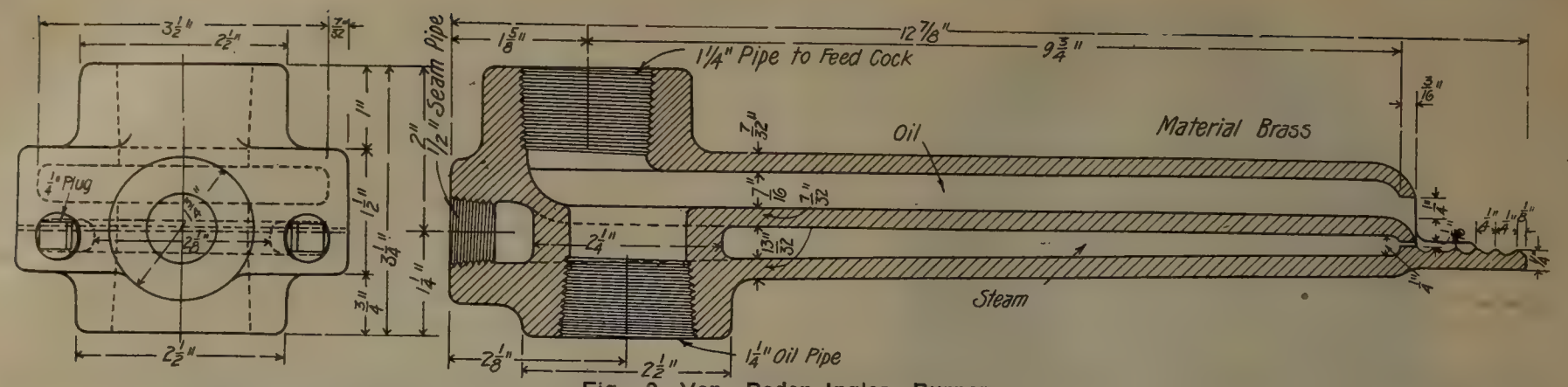


Fig. 2—Von Boden-Ingles Burner.

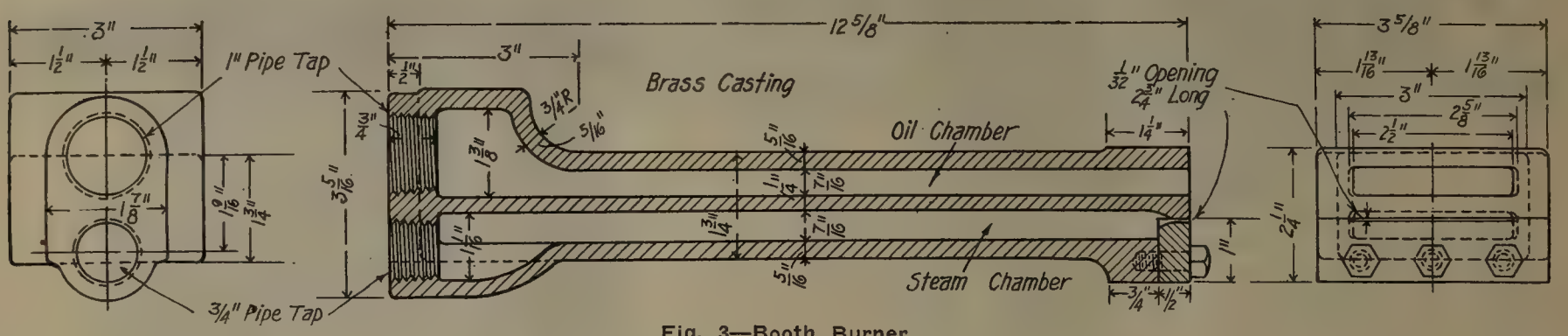


Fig. 3—Booth Burner.

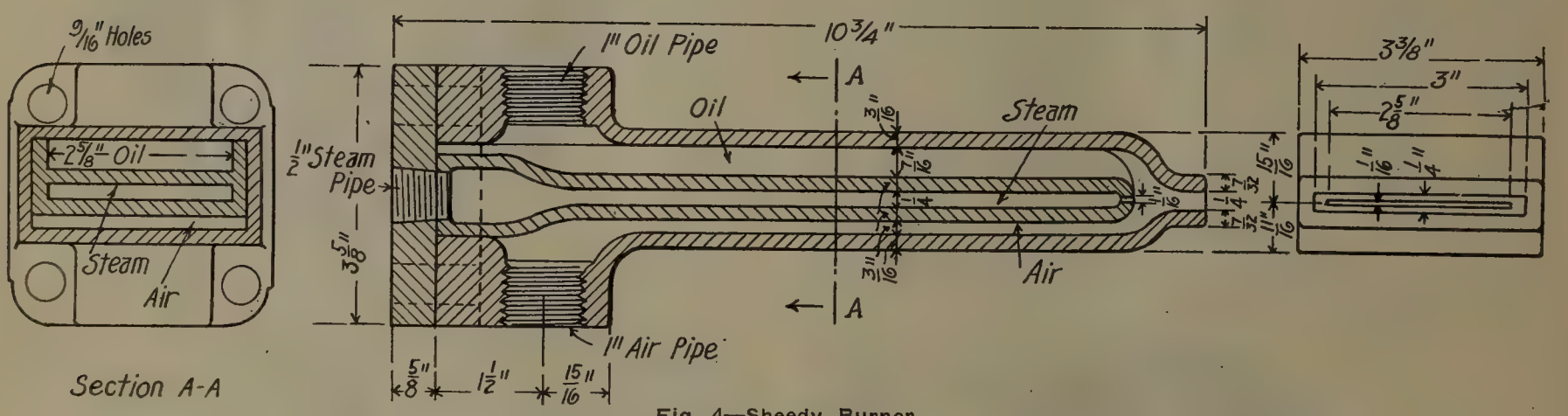


Fig. 4—Sheedy Burner.

on a projecting lip. The Sheedy burner, as will be seen in figure 4, is of rather different construction, consisting of three "slot" tubes, the upper one containing oil, the center one steam, and the lower one air. The steam is ejected just where the oil and air meet and the mixture is forced through the burner opening.

The general practice is to store the oil in large steel tanks at various division points, with convenient piping for transferring it to locomotive tenders. A number of illustrations of such installations on the San Antonio & Aransas Pass Ry. are shown later. Oil is usually purchased in the fields nearest to the territory through which the road operates, especially in the case of the southwestern roads, the various oils being used vary considerably in their characteristics. The data with regards to cost and effects on fireboxes, etc., also vary considerably. We present herewith the standard practices of the leading roads using fuel oil, together with data and results obtained, and are indebted to the mechanical department heads of the various roads for the information presented.

Southern Pacific Co.

The Southern Pacific is the heaviest user of fuel oil in the country and has had it in general use since 1900. At present there are 1,239 locomotives on its Pacific system, equipped for oil burning. This includes the Salt Lake division, which until recently was operated by the Oregon Short Line R. R. The Oregon Short Line still has a few oil-burners on the Yellowstone branch run, which are so equipped in order to conform to government requirements and which may be considered as having practically the same arrangement as the Southern Pacific engines. Oil fuel is used on all lines of the Pacific system except on the east end of the Salt Lake division; in other words, in the territory south of Portland and west of Carlin, Nevada, and Rio Grande, N. M., which comprises valley and mountain road and includes the Sierra, Siskiyou, Tehachapi and Beau-

Fig. 6—Southern Pacific Mallet Oil Burner, with Special Tender.

mont grades. The engines are of many different types and weights as may be seen from the following table giving the general dimensions of the latest standard engines:

Type	Weight on Drivers Lbs.	Diameter of Drivers	Cylinders	Grate Area Sq.Ft.	Heating Surface FireBox Sq. Ft.
American 8-wheel..	100,000	73 in.	20" x 26"	28.	166
Atlantic	105,000	81 in.	20" x 28"	49.5	174
Consolidation	187,000	57 in.	22" x 30"	49.5	177
Mallet Consolidation	394,700	57 in.	26"& 40"x30"	68.4	232
Mallet Mogul.....	320,100	63 in.	25"& 38"x28"	70.4	235
Mikado	205,000	57 in.	23¾" x 30"	70.4	235
Mogul	147,000	63 in.	21" x 28"	49.5	151
Pacific	141,000	77 in.	22" x 28"	49.5	174
6-wheel switch.....	140,000	51 in.	19" x 26"	30.2	140
10-wheel	160,000	63 in.	22" x 28"	32.1	206

Of the above, the 8-wheel switch, and 10-wheel locomotives have narrow fire-boxes, the 8-wheel and 10-wheel locomotives being especially designed to burn oil fuel.

The Southern Pacific has a number of locomotives with tenders of a semi-cylindrical form especially built for this use, with the oil compartment in front of the water compartment as shown in figure 6, but with the majority, the oil tank is built to fit in the coal space of the tender. The arrangement for heating the oil in the tender tanks is shown in figure 7.

58,000 pounds per square inch, with an elongation of not less than 26 per cent in 8 inches.

The method of bricking in use is shown in figure 5. These bricks have to be made of very refractory material. On an average a locomotive will go from two to three months between re-brickings, provided that repairs to the side walls are made in the meantime. The Von Boden-Ingles type of burner is used and no trouble is had with deposits in the fire-box unless the burner gets out of line, thus causing the flame to be thrown more to one side of the box than to the other. Repairs are about the same as for the coal burning locomotives if the fire is carefully handled and there has been no damage to sheets and flues with properly arranged boxes. In firing up, steam from the roundhouse is admitted to the atomizer line and also the blower. Steam for atomizing the oil is under about 80 pounds pressure.

The oil is used in crude form and is known as asphalt oil, being obtained from the Kern fields of the San Joaquin Valley. This oil is black in color, flows readily at 100° F. and has a calorific value of 18,500 B. t. u. as compared with

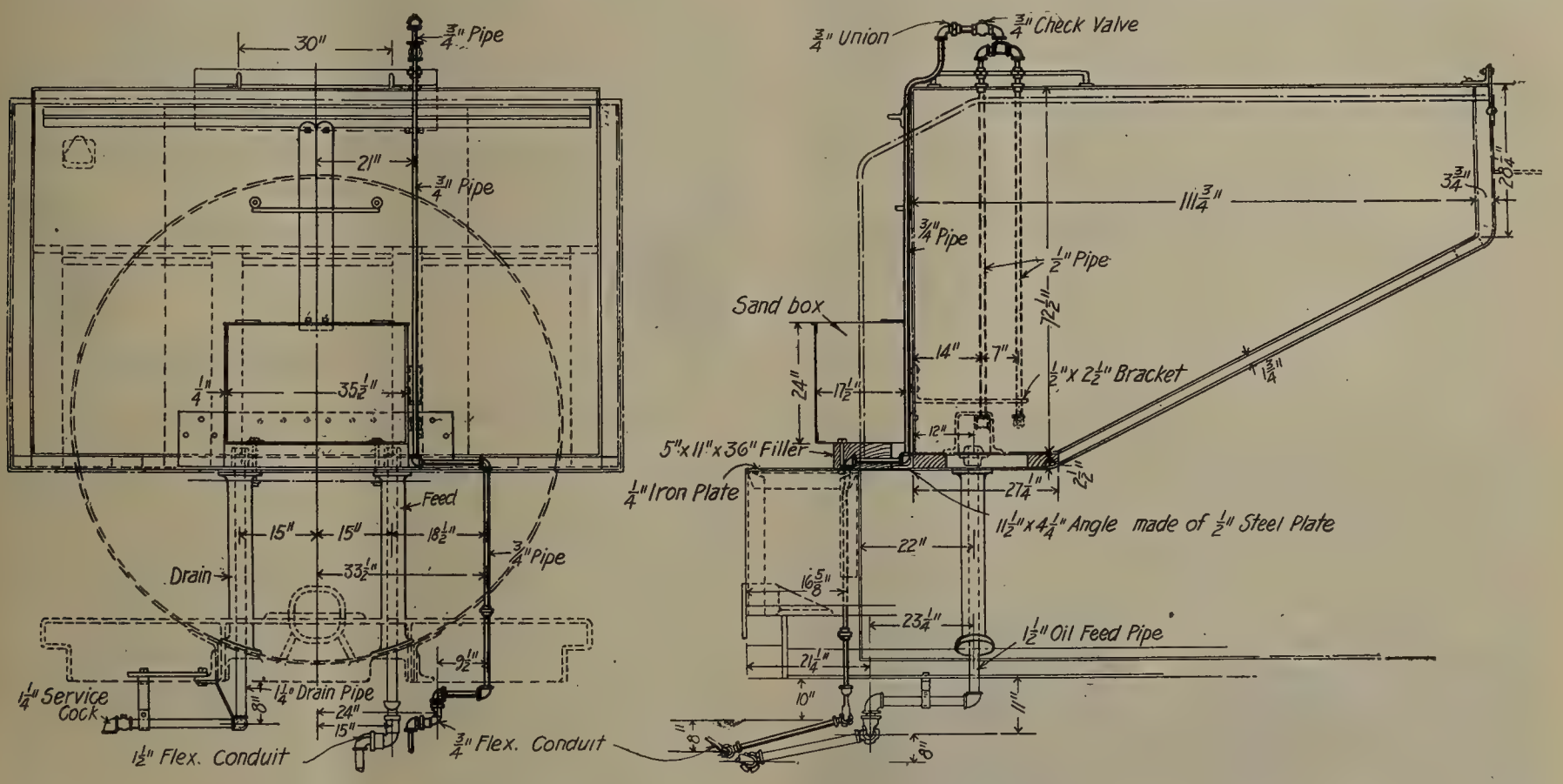


Fig. 7—Oil Piping Arrangement, Southern Pacific Co.

The system used is the "Direct Heater," that is, it discharges steam directly into the oil and usually heats it to 120° F. Formerly a coil heater was used, but it was found that in severe cold weather it was difficult to heat the oil properly. The tanks fitted with direct heater have a drain valve at the bottom, and by using this from time to time to draw off the water from condensation, no trouble is experienced. The valve seat for the drain is on the bottom of the tank and the valve seat for the oil feed is raised above the bottom in order that the water will not be taken into the burner. In addition to the heater in the tender tank, the oil on its way to the burner passes through a steam jacketed heater which is located beneath the fire pan on the locomotive.

Both broad and narrow fire-boxes, stayed with crown bars or with radial stays are in use. They are not equipped with brick arches. Narrow boxes have been found to be best adapted for fuel oil, but as some of the locomotives had previously been used for coal, and others had been designed to use either coal or oil, it has been found necessary to use the broad box in many cases. The fire box steel is open hearth, having a tensile strength of between 50,000 and 12,400 B. t. u. in coal which had been used. Its flash point is 250° F., specific gravity 15.8° Baume, and sulphur content .83 of one per cent. No difficulty has been experienced in getting firemen to use the oil-burners efficiently, and their use is practically universal on the lines of the Southern Pacific mentioned.

Atchison, Topeka & Santa Fe.

The Atchison, Topeka & Santa Fe has 865 engines equipped for oil burning on the various divisions of its western system and has used oil since 1887. The oil burners comprise representatives of practically all types of engines and are equipped with the Booth burner. They are not equipped with brick arches and the changes made in fire-box and tender are largely similar to those of the Southern Pacific. The draft pan and inside of the fire-box are lined with brick up to the bottom of the fire-door, the average life of the brick being three months. It has been found that there is no appreciable difference in repairs as compared with coal burning engines, although the oil burners are somewhat harder on fire-boxes and flues.

Crude oil from the local fields throughout the territory traversed is purchased at an average cost of 45 cents per

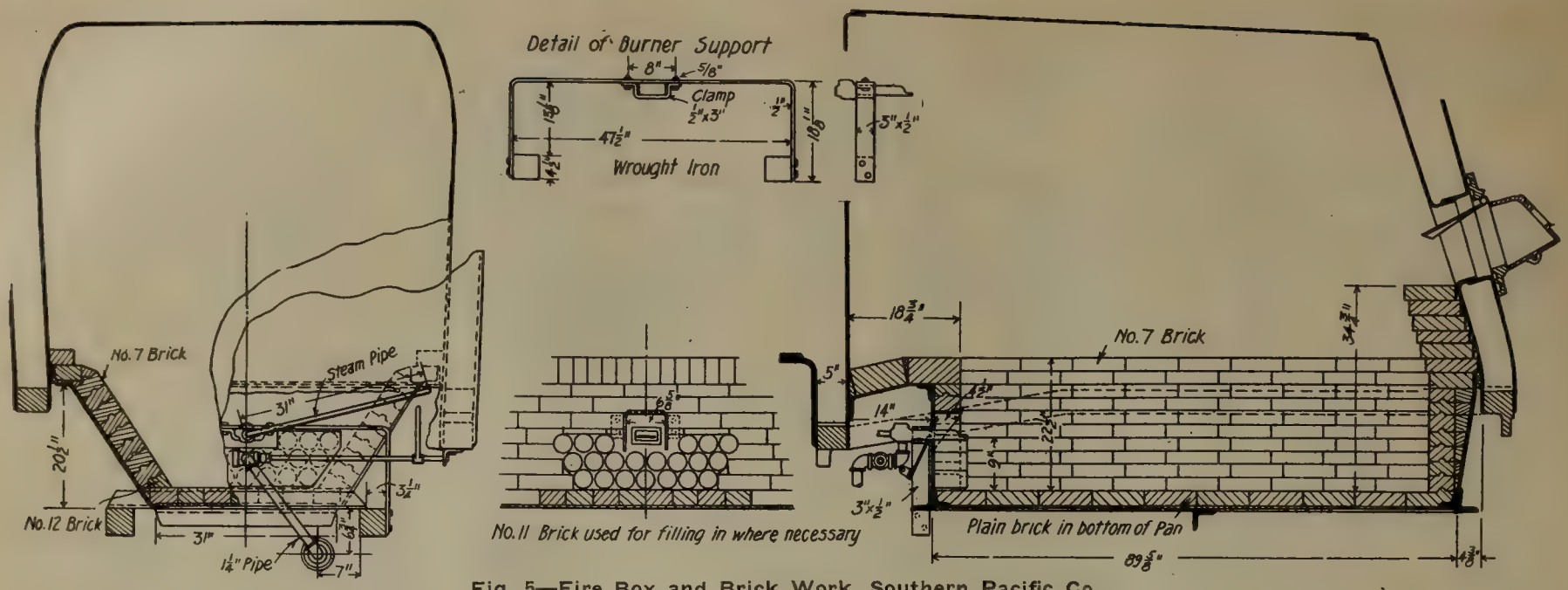


Fig. 5—Fire Box and Brick Work, Southern Pacific Co.

barrel It is black and viscous and has a calorific value of 16,740 B. t. u. as compared to 13,487 B. t. u. for the coal employed. Its flash point is 86° F., specific gravity .924, and sulphur content 1.86 per cent. No increase in engine tonnage over the use of coal has been effected and the cost per ton mile is .000270 cents. No difficulty has been experienced in getting firemen to use oil efficiently and it is contemplated to extend the use of oil where practical.

San Antonio & Aransas Pass Ry.

The S. A. & A. P. operates 725 miles of line in eastern Texas and its entire motive power equipment consisting of 81 locomotives is oil burning, oil first being used in 1900.

These engines are as follows: two 0-6-0 type, twenty 4-4-0 type, fifty 2-6-0 type and nine 4-6-0 type; the grate areas varying from 14½ to 29 square feet. For a 19 in. x 26 in. Mogul, weight on drivers 126,000 pounds, tractive power 28,500 pounds, and 200 pounds steam pressure, the grate found to give the best results has an area of 27½ square feet. Radial stays and crown bars are of Otis steel, tensile strength 52,000 pounds. Figure 8 shows a design of crown stay which is used on the S. A. & A. P. and which is said to be a long-lived and efficient stay for oil burners. Figures 9 and 10 show the tender and fire-box arrangement. No brick arches are used and the engines are equipped with Sheedy 3-inch burners. The life of the firebrick is about 60 days. Figures 11, 12 and 13 illustrate the oil storage tanks and figure 14 shows the manner of delivering oil to the tender.

Tank cars of 10,000 gallons capacity are used. Crude oil is purchased in the Beaumont and Humble oil fields. It is of a dark brown color, flows freely at 60° F. and has a calorific value of 19,000 B. t. u. Its flash point is 200° F., specific gravity 0.92 at 60° F. and it has 1 per cent of sulphur. An increase of 25 per cent in tonnage has been effected and

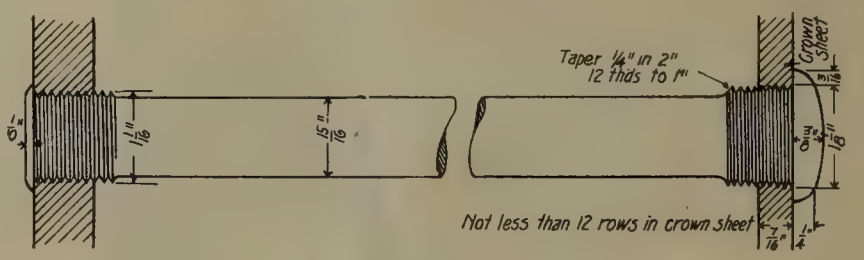


Fig. 8—Crown Stay for Oil Burner, S. A. & A. P. Ry.

the cost per ton mile for oil fuel is .000323 cents for freight, .000490 cents for passenger and .000463 cents for mixed, giving a grand average of .000347 cents. Repairs cost about 30 per cent more than with oil burning engines and the life of fire-boxes and flues is reduced in about the same proportion. All new engines are to be equipped for the use of fuel oil. Some difficulty has been had in getting firemen to use oil efficiently, but this has been largely overcome by supplying men with a booklet giving rules and information

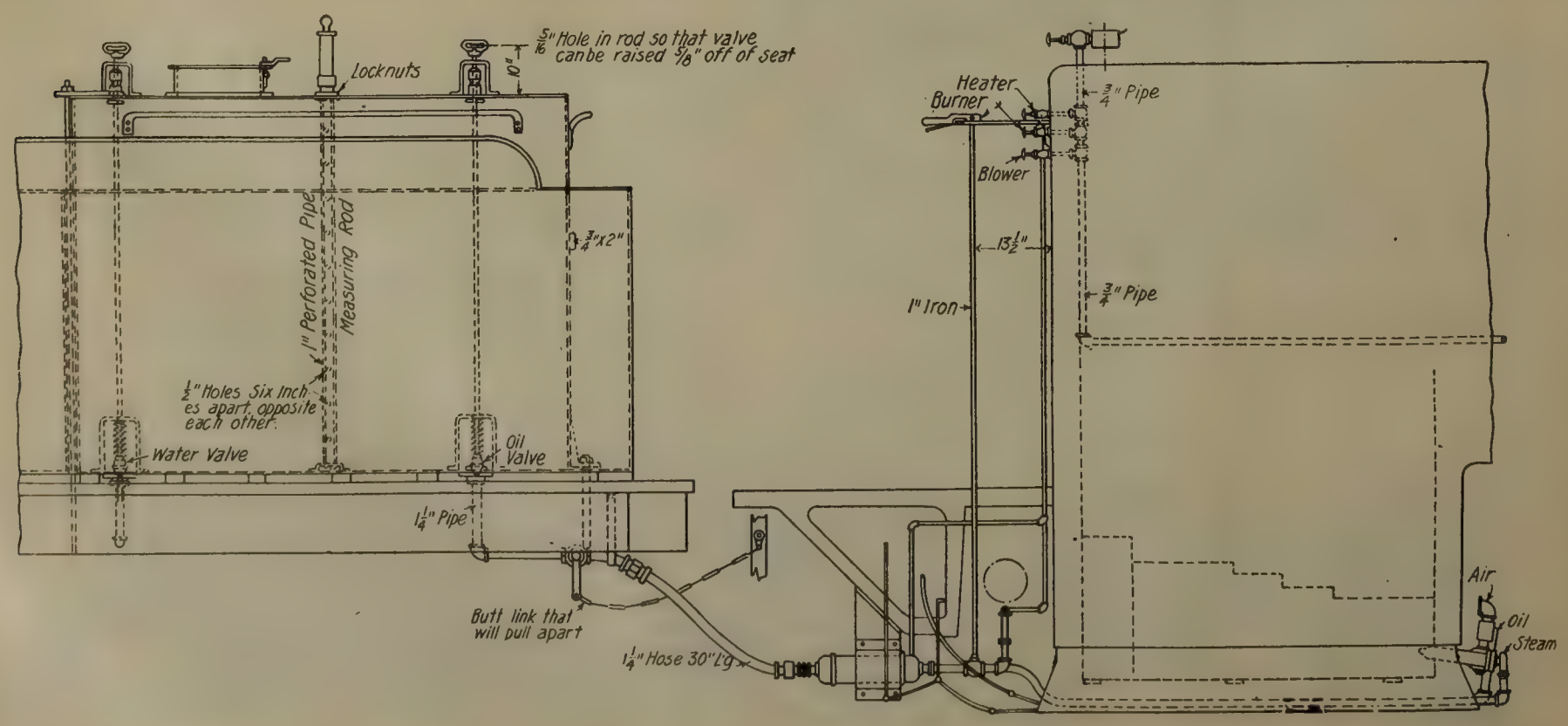


Fig. 9—Fire Box and Tender Arrangement, S. A. & A. P. Ry.

with regard to oil burning. This was gotten up by G. W. Taylor, superintendent of motive power, and contains so much of interest that we quote liberally from the introduction.

"In locomotive operation, fuel costs and consumption are the most important factors and the highest evaporative performance that can be obtained per dollar expended for fuel is the conditions desired.

"Higher rate of evaporation per gallon of oil and the more efficient rates of combustion can be obtained by engineers and firemen exercising the proper attention and vigilance towards securing more perfect fuel oil combustion.

"The problem of smoke prevention is the problem of perfect combustion, the elimination of smoke is an indication of careful firing, in addition to gaining the best results in steam generation.

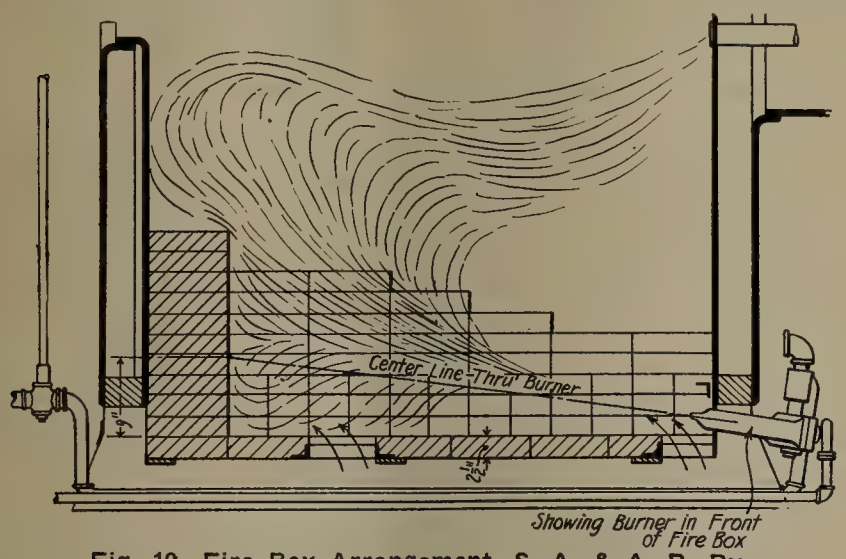


Fig. 10—Fire Box Arrangement, S. A. & A. P. Ry.

"It is within the province of every engineer and fireman to attain the highest degree of efficiency by producing smokeless combustion in the fire-box of the locomotive.

"The relative expense of oil and coal as a locomotive fuel is a subject of vital importance to both the railroad company and enginemen. A discussion of the possible economies that can be effected in the use of oil, when figured against coal in actual practice, will bring forth some startling data and inefficiencies.

"The laws of combustion in coal burning engines are equally applicable to the oil burners. Heavy charges of fuel oil have a cooling effect on the fire, and fire-box, reducing the temperature below ignition point, allowing the unconsumed gases to pass into the tubes and out of the stack in the form of black smoke. The waste of fuel is identical, no matter whether the oil is poured on the ground in a solid, or converted into a gaseous form and emitted

Fig. 11—Oil Sump Tank, S. A. & A. P. Ry.

Fig. 12—Oil Sump Tank, S. A. & A. P. Ry.

from the stack in dense volumes of smoke. The manipulation of oil burning locomotives should be given the same consideration as the coal burning locomotives when pulling out of stations, in order that the temperature of the firebox may be increased to ignition point before the engine is worked to its full capacity. The temptation of the average engineer in handling oil burning locomotives is great, and the tendency is to work the engine decidedly stronger with more notches on the quadrant and a more wide open throttle than could possibly be done with the coal burning engine and maintain the steam pressure and water level. A little more oil in addition to a wider opening of the atomizer re-inforced by the frequent sanding of the engine, will usually suffice to overcome the increased unnecessary demand of the reverse lever and wider throttle opening, with a consequent waste of fuel incident to the failure on the part of enginemen to profit by the expansive use of steam in the locomotive cylinder. The handling of the engine in this manner is responsible for the actual ratio of oil consumed running higher than that shown by careful tests and skillful

Fig. 13—Oil Storage Tanks, S. A. & A. P. Ry.

locomotive management. In addition to this, an excessive consumption of oil is the cause of a comparative lack of steam failures as compared with the coal burning engines, and also results in the lack of supervision and manipulation of the various accessories on the part of enginemen. Mechanical defects which are not given the proper attention, due to the failure on the part of the enginemen to inspect and report the defects in the various appliances used on the oil burner, would show a decided saving in fuel if given proper attention."

Chicago, Rock Island & Pacific Ry.

The Rock Island first used oil as a fuel in 1908 and at present has 69 engines equipped for oil burning, being distributed as follows: 13 small switch, 1 Mogul, 4 small 8-wheel engines, 20 ten-wheel simple, 23 consolidation, and 8 Pacific. These are operated in the territory between Her-

ington, Kan., and Waurika, Okla. The sizes and heating surfaces are as follows:

	Size Firebox.	Grate Area.	Heating Surface.
10 wheel simple.....(11)	8' 5"x2'9"x6'	23 sq ft.	1839
10 wheel simple.....(9)	9'10"x3'4"x6'8"	33 sq. ft.	2790
Consolidation .....(22)	8'11"x5'7"x6'5"	50 sq. ft.	3196
Consolidation .....(1)	10' x6' x6'4"	60 sq. ft.	3846
Pacific .....(7)	7' x6'2"x6'4"	43 sq. ft.	3122
Pacific .....(1)	9' x5' x6'8"	45 sq. ft.	3572

All of the Rock Island oil burners are equipped with brick arches and the Ingles-Von Boden type of burner is

Fig. 14—Oil Column Delivery, S. A. & A. P. Ry.

used. On the majority of the tenders, oil tanks have been fitted into the coal space, but on the remainder the sheets of the coal space have been riveted to the floor. This latter method has not been found very satisfactory on account of water and oil getting mixed.

One large storage tank of 1,000,000 gallons capacity is located at El Reno, Okla., with smaller tanks at Herington, Caldwell, Wichita, Chickasha, Waurika and Oklahoma City. The oil is received from the Kansas fields at Stuart, Okla., and oil from the Oklahoma field is pumped to Stuart, Okla., through a pipe line. Tank cars are leased from outside concerns and operate between Stuart and points between Caldwell and Waurika. The oil is crude and very dark in color. The oil burners have not been in service long enough to determine definitely the effect on the firebox, although it is believed that they are a little harder on it than coal burners.

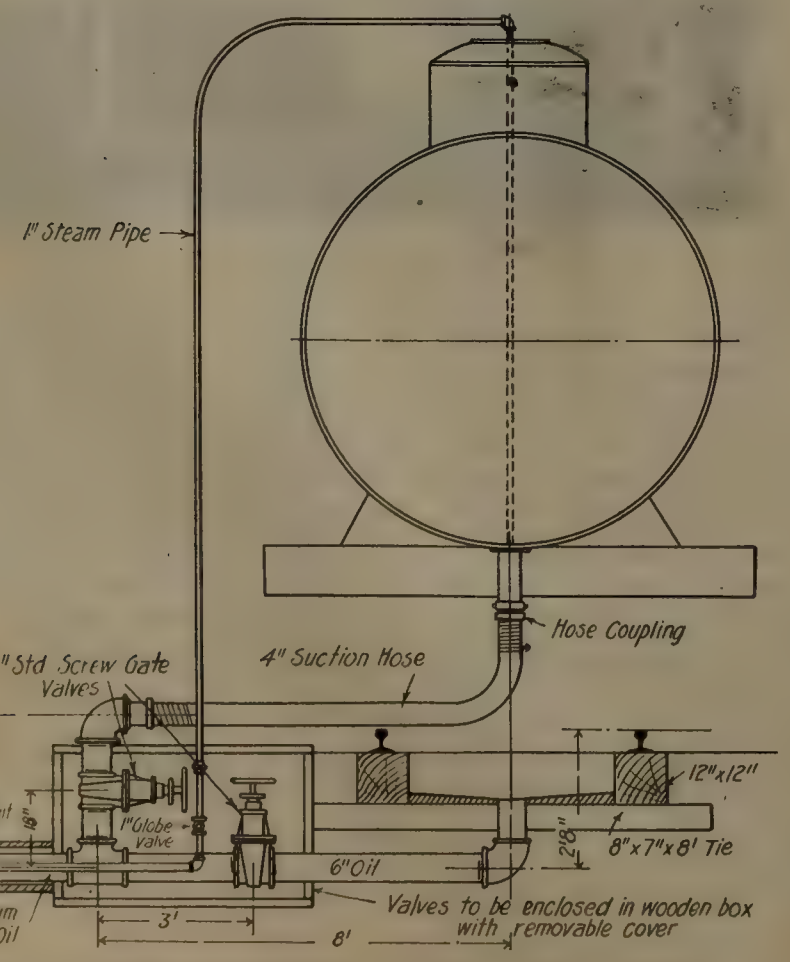


Fig. 16—Unloading Connection at Sump, Western Pacific Ry.

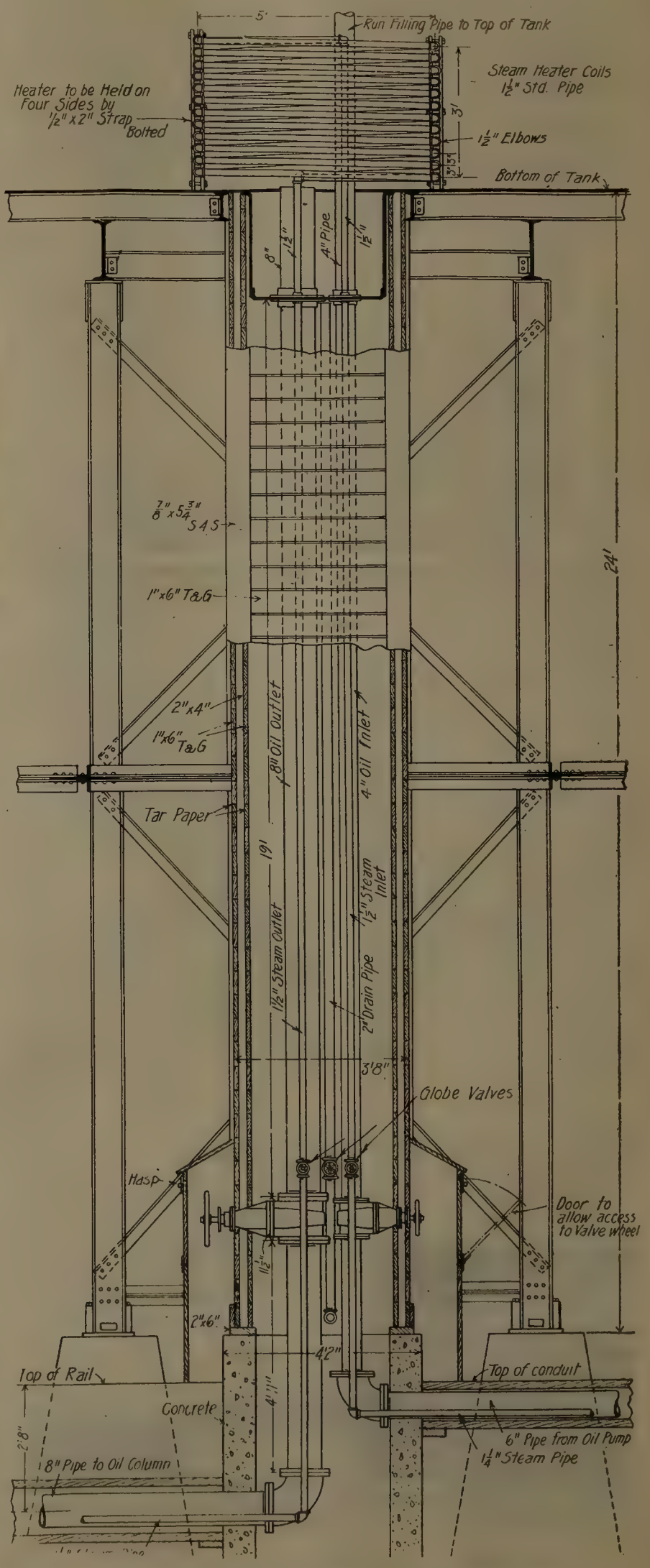


Fig. 17—Piping and Heating Oil for 75,000-Gallon Oil Tank, West. Pac. Ry.

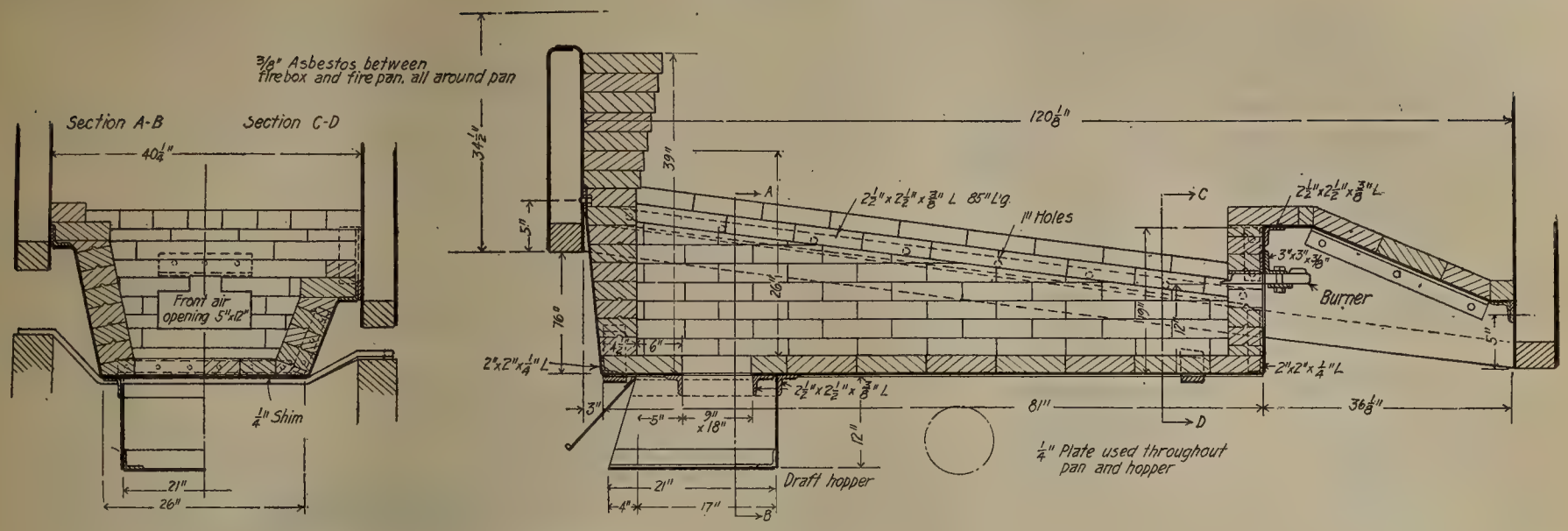


Fig. 15—Fire Box and Bricking, West. Pac. Ry.

No figures as to the cost per mile are available, but it is stated that the oil burners increase engine tonnage from 15 to 20 per cent. Some difficulty has been experienced in getting firemen to handle oil economically, but this is gradually being overcome by proper instructions. Owing to the unsettled price of oil in the southern territory, it is not expected that any additional engines will be equipped for oil burning for some time to come. However, this has not been definitely settled.

Western Pacific Ry.

Oil burning engines have been in use on the Western Pacific but a short time, the road itself having been opened only about three years ago. At present it has 67 in service in California and Nevada. The road has altogether 115 locomotives, so it will be seen that over half its equipment is oil burning. These engines are new and were equipped by the builders for oil burning. They are divided as follows: 36 consolidation freight, 23 ten-wheel passenger and 8 six-wheel switch engines. The heating surfaces are:

	Firebox.	Total.
Freight	218 sq. ft.	3,070 sq. ft.
Passenger	193 sq. ft.	2,597 sq. ft.
Switch	172 sq. ft.	1,804 sq. ft.

The fireboxes are of 3/8-inch steel, radial stayed, with 33.6 square feet grate area on freight and passenger engines and 31.4 square feet on switch engines. All of the different types of burners are in use. Fireboxes are not equipped with brick arches. The ash pan arrangement and method of bricking is shown in figure 15, Mount Savage firebrick being generally used. Practically no trouble has been experienced with deposits in the firebox. California crude oil is purchased from the Standard Oil Company and unloaded to a sump as shown in figure 16, from whence it is pumped to the storage tank. The oil in the tank is heated by a steam coil at the bottom, as illustrated in figure 17. The drain, it will be noted, is from a catch basin immediately underneath the coils.

No trouble has been experienced in getting enginemen to use oil efficiently. The engines have been in service too short a time to give any comparative figures on costs, but very little trouble has been had with fireboxes and flues.

Great Northern Ry.

At present the Great Northern has 115 engines equipped with burners, out of a total of 1,192. One of these engines has been in service about three and a half years, while the others have been in use about six months. The types so equipped are: six-wheel switch engines, eight and ten-wheel passenger, Moguls, consolidation freight, mastodon freight and some Mallet freight engines of the 2-6-6-2 type. It is also contemplated to equip some heavy freight engines of the Mikado type. These engines are in use on the Spokane and Cascade divisions, embracing the main line along the Pacific Coast and over the Cascade mountains. This includes the territory from Portland, Ore., to Vancouver, B. C., and from Seattle to Leavenworth, Wash.

Boilers are mostly of the Belpaire type. The heating surfaces and grate areas are as follows:

	Grate Areas.	Heating Surfaces.
Switch engines	14-27 sq. ft.	1143-1873 sq. ft.
8-wheel passenger	16-17 sq. ft.	1043-1212 sq. ft.
10-wheel passenger	24-32 sq. ft.	1797-2281 sq. ft.
Mogul	18-21.5 sq. ft.	1308-1598 sq. ft.
Consolidation	24-35 sq. ft.	1596-2835 sq. ft.
Mastodon	35 sq. ft.	2863 sq. ft.
Malletts	53.78 sq. ft.	3914-5700 sq. ft.

The above are not equipped with brick arches. The Von Boden-Ingles burner is used. Keyed St. Louis brick are used and although engines have not been in service long enough to determine definitely the life of brick, it is estimated they should last between

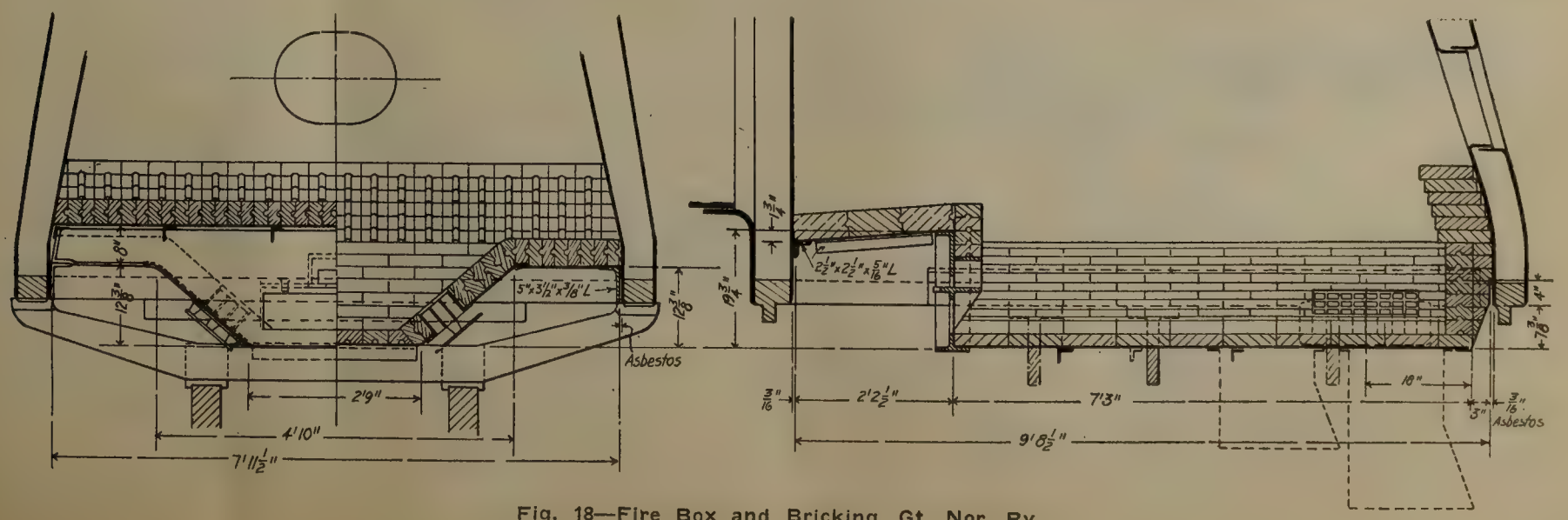


Fig. 18—Fire Box and Bricking, Gt. Nor. Ry.

shoppings. A cross-section of the firebox is shown in figure 18.

Black California crude oil is used, containing about 18,500 B.t.u. per pound as compared to 14,000 B.t.u. in the coal formerly used. Its flash point is about 190° F. and the specific gravity 15.8 Baume. All oil is received at Everett, Wash., in three storage tanks having a capacity of 55,000 barrels each. These tanks are of steel, 30 feet high, 114 feet in diameter. 65,000 gallon steel tanks on 30 foot steel towers are located at Interbay, Wash., Burlington, Wash., and Leavenworth, Wash. A 10-000 barrel tank, without a tower is also located at Leavenworth

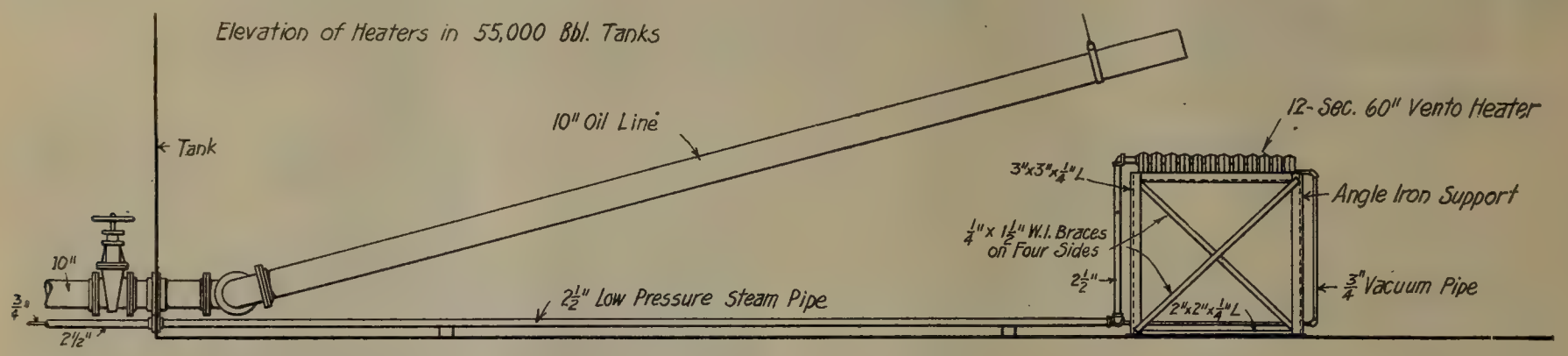


Fig. 19—Oil Tank Heater, Gt. Nor. Ry.

At Delta, Wash., there is a 65,000 gallon steel tank on a 12-foot concrete base. 100,000 gallon tanks are located at Skyhomish, Wash., and Cascade Tunnel. The former is on a 30-foot steel tower, while the one at the tunnel is located on the ground. These tanks are heated by coils placed at the bottom as illustrated in figure 19. This illustration is of the 55,000 barrel tank near Everett. With the smaller tanks, the oil outlet is directly beneath the heater. The sump into which the oil is drawn from the tank cars is heated as shown in figure 20. Seventy-five tank cars of 12,000 gallons capacity are used for transporting oil between Everett and the distributing points.

As yet no difference has been found in the cost of repairs of oil burners as compared to coal burners. The increase in engine tonnage has been about 3 per cent and the cost per ton mile is .000487 cents. But little difficulty has been experienced in getting firemen to use the oil to advantage and it is contemplated to extend the use of fuel oil.

Chicago & North Western Ry.

The North Western has had one oil burning engine in service for five years and a few more for two or three years. At present it has about twenty-five oil burners, most of which have recently been put in service. The North Western is therefore a novice in the oil-burning field and no definite conclusions are available at present. The engines at present equipped are in both freight and passenger service, both wide and narrow fire boxes being used. The engines are of the following classes:

Atlantic, 20 in. x 26 in. cylinders.

Pacific.

10-wheel—18 in. x 26 in., 20 in. x 26 in. and 21 in. x 26 in.

8-wheel—17 in. x 24 in. cylinders.

6-wheel switch—17 in. x 24 in. cylinders.

cylinders.

Narrow gauge (two)—16 in. x 20 in. cylinders.

These engines are in service in Wyoming and Nebraska between Lander and Norfolk, and also in the Black Hills district. They are not equipped with brick arches. The coal space in the tender is fitted with an oil tank in the usual manner and both the Barco and McLaughlin flexible joints are used between the tender and engine. The Booth burner is used at the front end of the firebox. It was attempted to use the burner at the rear end of the firebox at first but the results proved very unsatisfactory.

Oil is received direct from the refineries at Casper, Wyo., and tanks having a capacity of 5,000 barrels have just been erected at Chadron and Long Pine, Neb. Both crude and refined oil are being used, the crude being black in color and the refined of a greenish color. Its flash point is 110 deg. F. and the specific gravity 20 deg. to 30 deg. Baume.

Canadian Pacific Ry.

The mechanical department of the Canadian Pacific has been gathering information on oil burning equipment for the past year and is at present building storage tanks and equipping 90 of its engines for oil burning in British Columbia. The decision to adopt oil on the mountain subdivision of the British Columbia division was made primarily to prevent forest fires, possibly caused by sparks, and thereby conserve the natural resources in timber. Not only do these fires play havoc in the forests but in

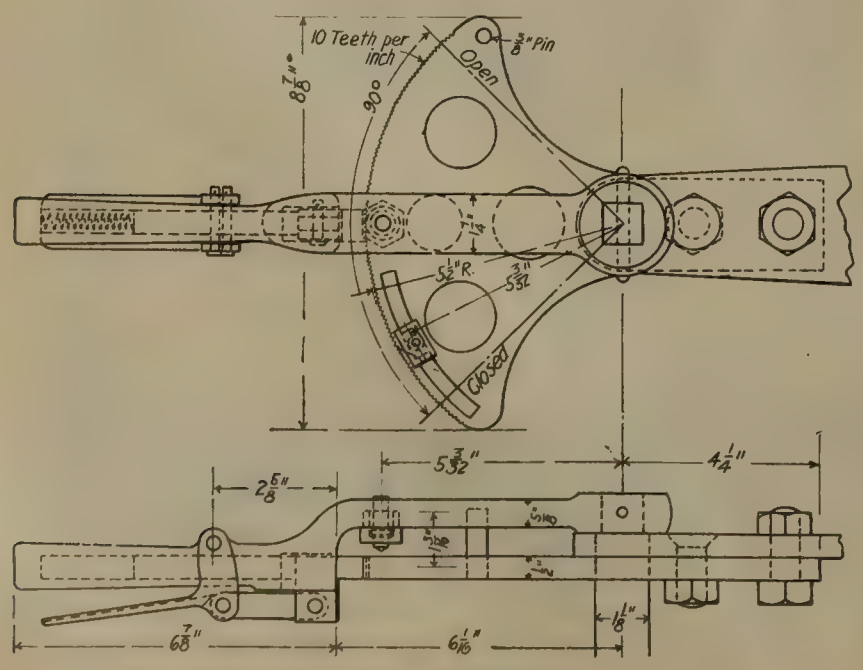


Fig. 22—Quadrant for Oil Burners, C. P. Ry.

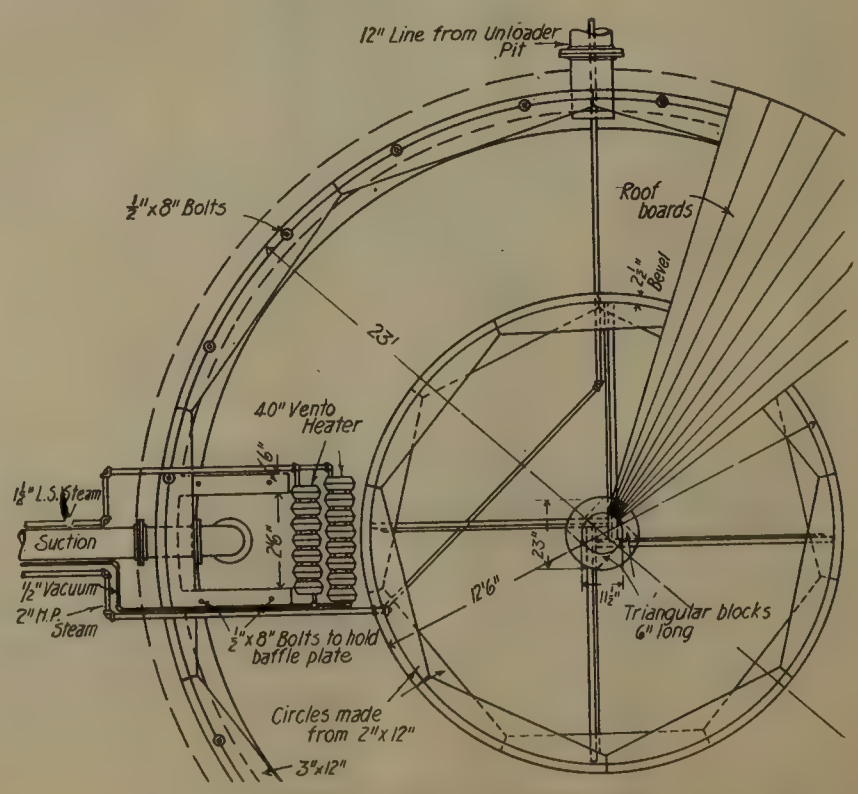


Fig. 20—Plan of Sump, Gt. Nor. Ry.

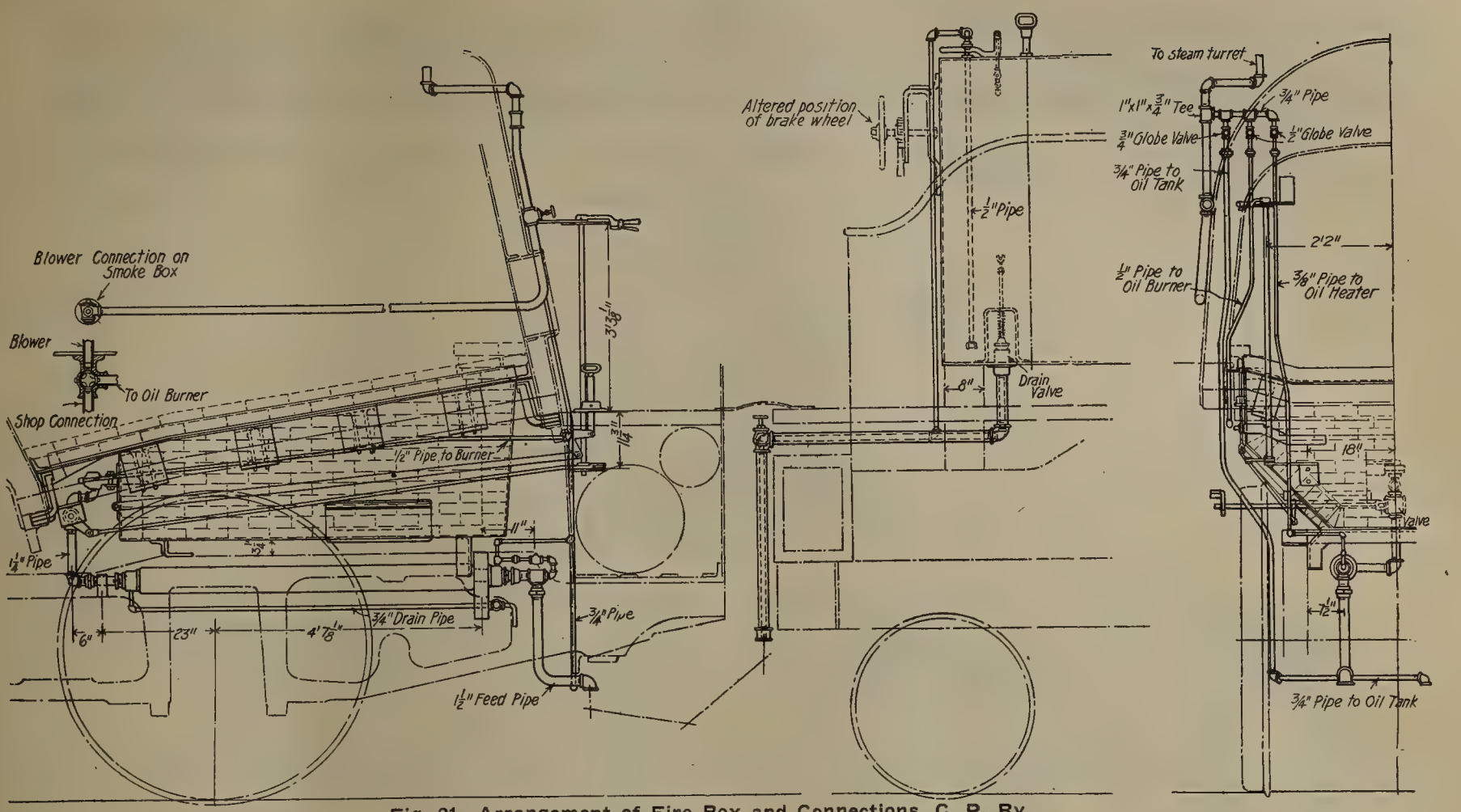


Fig. 21—Arrangement of Fire Box and Connections, C. P. Ry.

baring the mountain sides they result in snow and mud slides. The adoption of oil should prove an economy from the company's standpoint as it is expected that it will facilitate a more rapid and even movement of freight trains on ascending grades and will result in elimination of any waste consumption at terminals. The changes are being put in effect with all possible speed. The following table gives the heating surface and grate areas of the engines being equipped:

Class	No. in Class	Heating Surface Type	Heating Surface Total	Grate Area
N-3	41	2-8-0	3001	49.5
R-1	6	0-8-8-0	3417	59
D-9	16	4-6-0	2850	49.6
D-3	2	4-6-0	1291	23.4
D-4	11	4-6-0	1299	28
L-3	1	2-8-0	1731	32
L-5	3	2-8-0	1872	32.5
U-3	1	0-6-0	1544	52
V-1	2	0-8-0	2005	32.7
D-5	6	4-6-0	1593	31.8
A-5	1	4-4-0	1150	17

The engines are not equipped with brick arches and are to

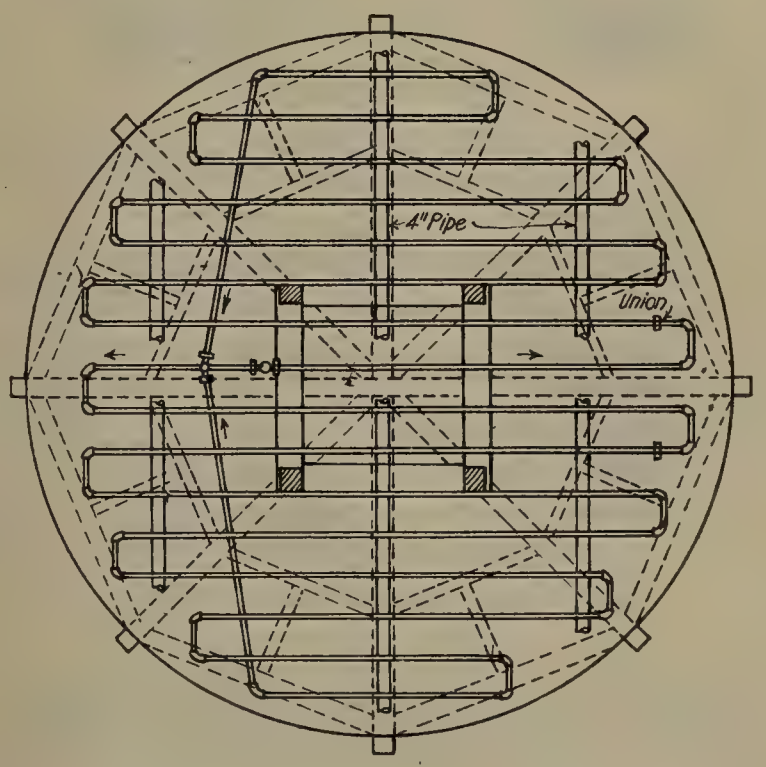


Fig. 25—Showing Heating Coils on Bottom of Oil Tank, C. P. Ry.

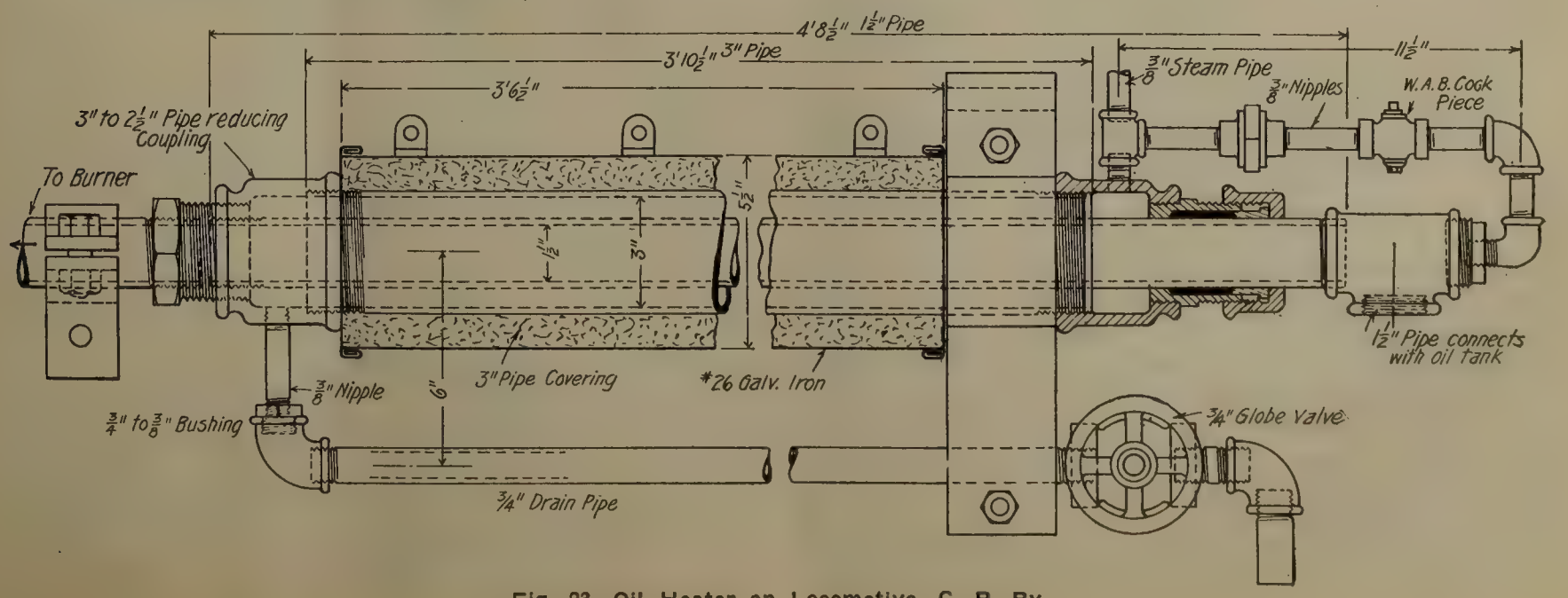


Fig. 23—Oil Heater on Locomotive, C. P. Ry.

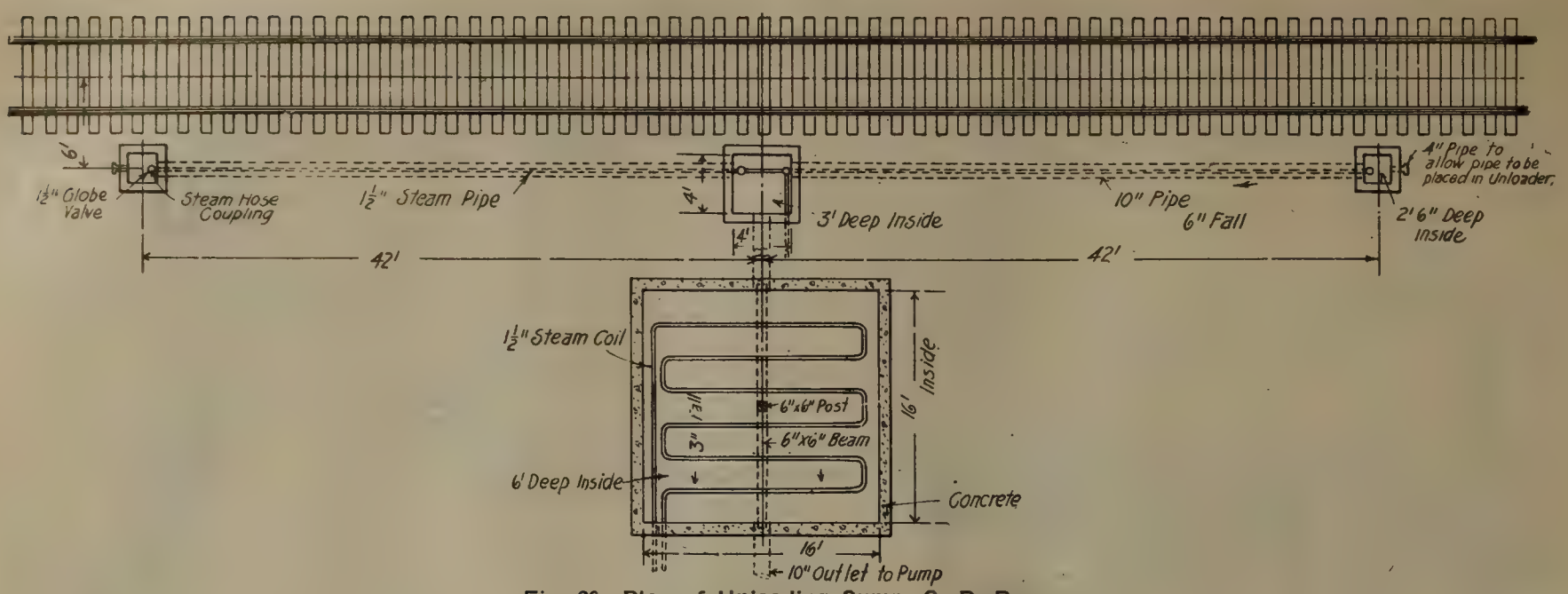


Fig. 26—Plan of Unloading Sump, C. P. Ry.

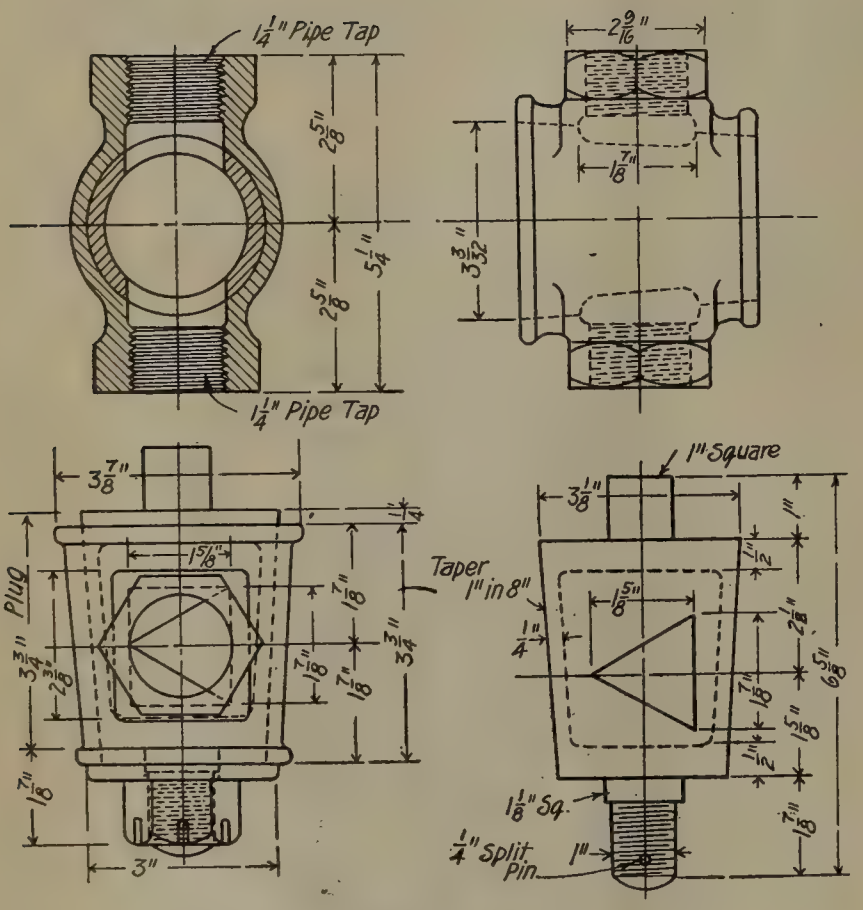


Fig. 24—Oil Regulator Valve, C. P. Ry.

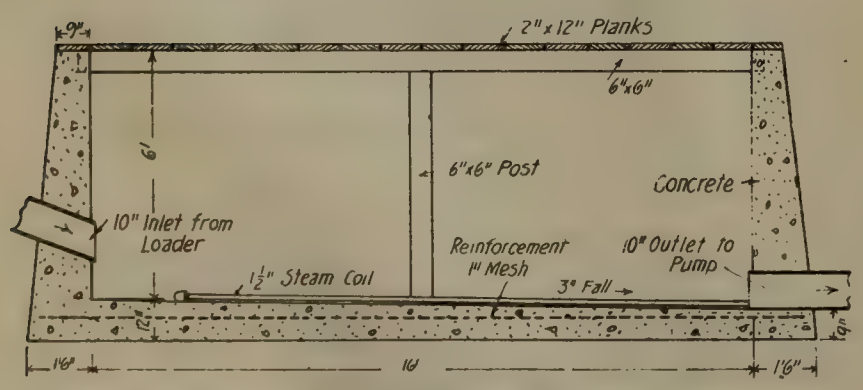


Fig. 27—Section Through Sump, C. P. Ry.

have Von Boden-Ingles burners. Of course no results of the use of oil burners on the Canadian Pacific are yet available. The arrangement of the firebox, together with the connection at the tender, is shown in Figure 21. It will be noted that it is similar in many respects to that in use on the Southern Pacific. One and one-half inch McLaughlin flexible conduit is used between the engine and tender. The quadrant for controlling the burner is shown in Figure 22. The oil tank has a capacity of 3,000 imperial gallons and is heated by discharging steam directly into the oil. There is also another heater consisting of a steam jacket just before the oil reaches the burner, shown in Figure 23. The heat for the drain pipe in the tender is placed flush with the bottom of the tank and the seat of the oil outlet is raised a few inches. The oil regulator valve is shown in Figure 24. It will be noted that the passageway is three-cornered, which gives a finer regulation.

Oil will be received at Vancouver, B. C., and storage tanks of steel construction are being installed at a number of points.

At Revelstroke, a tank with a capacity of 22,000 barrels, is being installed and tanks with a capacity of 15,000 barrels each are being placed at Kamloop, Field and Rogers Pass, all in British Columbia. Smaller distributing tanks of 600 barrels each are being placed at Notch Hill, Sicamour Junction and Golden. Distributing tanks will be installed at the points of storage and the arrangement of the pipes will provide for pumping from large tanks to distributing tanks. The material for the larger tanks is being supplied by the Petroleum Iron Works Co., of Sharon, Pa., and for the smaller ones by the Hammond Iron Works, of Warren, Pa. A 600 barrel oil tank on a 20 foot steel tower is also being erected at Vancouver,

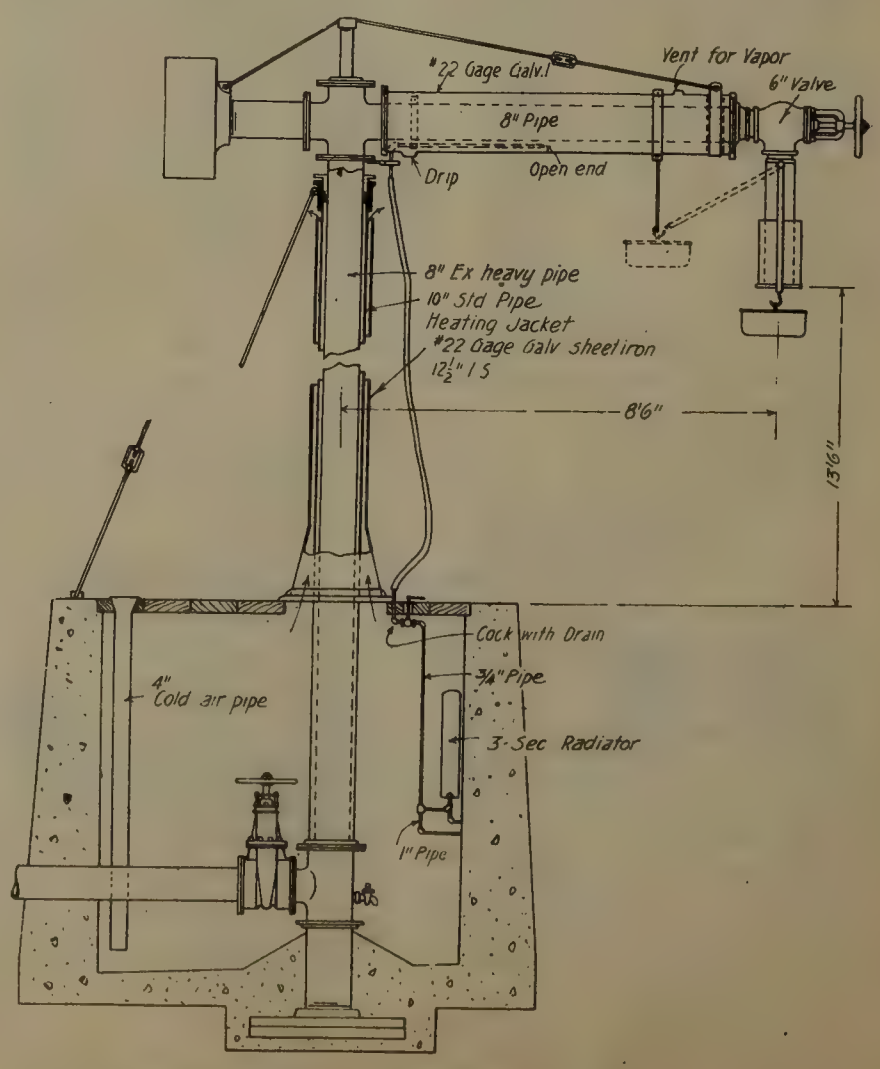


Fig. 28—Oil Standpipe, C. P. Ry.

Road.	In Use Since	No. Locos.	Where used	Brick Arch	Effect on Sheets and Flues	Burner	Oil				Cost per ton-mile for fuel	Increase in Engine Tonnage
							Where Obtained	Calorific Value	Flash Point	Sulphur		
A. T. & S. F.	1887	865	South-western divisions	No	"No definite information"	Booth	Local fields	16,740 B. T. U.	83° F.	1.88%	.0270 cents	None
Can. Pac.	Now being equipped	90	British Columbia	No		Von Boden-Ingles	California					
Chi. & N.-W.	1911	25	Wyoming and Nebraska	No		Booth	Wyoming		110° F.			
C. M. & St. P.	1909	126	Wash. Ida. and Mont.	No	Repairs average 25% more	Booth	Bakersfield, Cal.	19,000	215° F.			Some
Chi. R. I. & P.	1908	69	Herington, Kan., to Waurika, Okla.	Yes	"A little harder than coal"	Von Boden-Ingles	Kansas and Oklahoma					15 to 20%
G. H. & S. A.	1900	310		No	Little or no difference	Sheedy	Tex. La. and Okla	19,200	118° F.	2%	.024 cents	10%
Great Nor.	1911	115	Spokane and Cascade divisions	No	"Probably a little shorter life"	Von Boden-Ingles	California	18,500	190° F.		.0487 cents	About 3%
San A. & A. P.	1900	81	Entire system (Southern Texas)	No	"Reduces life 30 per cent"	Sheedy 3 in.	Beaumont and Humble fields, Texas	19,000	200° F.	1.0 %	.0347 cents	25%
Sn. Pac.	1900	1239	On entire Pacific system except east end of Salt Lake division	No	"No bad effects if properly arranged"	Von Boden-Ingles	San Joaquin Valley, Cal.	18,500	250° F.	.83%		
Tehuantepec National	....	60	Southern Mexico	No	"No trouble whatever"	Booth	Texas and Mexico	19,000	160° F. and 104° F.	.77% and 3.44%		
West. Pac.	1909	67	California and Nevada	No	"Very little trouble"	All commercial types	California					

B. C. Figure 25 shows the arrangement of the heaters for the oil tanks.

Figure 26 shows the plan of the unloaders and sump, and Figure 27 shows a cross-section of the sump. A trough is placed beneath the tank car and the oil is run into the small boxes from whence it runs through pipes to the sump. It will be noted that the steam coil is spread over the bottom and is not placed just in front of the oil outlet as on the Great Northern. In Figure 28 is shown an elevation view of the oil standpipe. Note the drip pan under the spout.

(To be Continued)

AMERICAN RAILWAYS.

As Viewed from India by "Indian Engineering," Published at Calcutta. In It We See Ourselves as Others See Us.

It is somewhat surprising that the United States with its vast ramification of railway lines, is still a long way behind in organization to the railway system in Great Britain and even that on the Continent. The mileage of the railways is five times per capita that of Europe, the freight traffic per mile is three times as great, but yet the rate per ton mile is less than half the average of that in Europe. The natural result of course is that, with certain notable exceptions, the working costs have to be kept down to the lowest limit possible, and lines have to be built with an eye more to economy than efficiency. To control the railways with the same rigidity, therefore, as lines are controlled elsewhere is out of the question; and equipment and working appliances have to be permitted that would be ruled out elsewhere. The disadvantages of the system, however, are being clearly perceived all over the country and a general call is being made for the state to permit an enhancement of rates and at the same time to adopt a system of control over the operation of inter-state railways similar to what is exercised by the British Board of Trade. To take up some of the features that ought without more delay to be improved we may refer to the following. With regard to railway accidents there appears to be no authority vested in anyone to deal with and pass orders upon defects in equipment or working that may have lead to them, the functions of state officers being apparently merely confined to investigation and report. The use of the block system is not compulsory on all passenger railways, nor have the operating rules been standardized for all inter-state lines. When an accident occurs it is usually investigated by the inspectors of safety appliances, because it is supposed that their special training qualifies them for such work; but complaint is at the same time made that many of the railways have inefficient inspectors, and also that reports of accidents are not printed. As regards traffic and accounting there also seems to be room for much improvement, since during the fiscal year ending 30th June, 1910, no less a sum than 22 million dollars had to be paid out in settlement of claims for loss or damage to freight; also, that undercharges are frequent and there is great laxity in recovering them, cases having occurred of claims for undercharge being put forward after a lapse of two years. Such lapses give rise

to the suspicion that the railway, or some officer of it, has advisedly given a rebate to the shipper; and it is now proposed to limit the time for recovery of an undercharge to three months. The development, again, of cars and engines is being permitted without a corresponding betterment of the track, resulting in more frequent derailments. It appears to us that at the bottom of all these evils lies the fact that the railways in the States are at the present time earning scarcely a living rate. Though the state has but a lax grip over the companies as regards methods of working, leaving competition to take care of that, it rigidly controls rates; and having some 15 years ago brought them down to a point which then yielded a fair profit, has kept them since at the same level, compelling lines, in order to meet expansion in one direction, to economize rigidly in another, while costs of both labor and materials have in the same period risen enormously. Thus, if a company must, for the sake of competition with rival lines, invest in better engines and cars it has to take their cost out of maintenance, taking the risk of accidents from inadequate permanent-way, or weak bridges, both which might have been strengthened at the same time as the running equipment was improved, had there been means to do it. Expenditure on new lines and on branches has therefore given place to expenditure merely to meet competition, with the result that the development in mileage has slackened till from having been recently about 8 per cent, it is now only about 2 per cent, which is less than the rate of growth of the population. There are thus two elements of danger in keeping down railway rates for the benefit of shippers—(1) that there will be a tendency to equip the line with appliances that will bring a direct return and take risks with appliances that are merely contributory to the working, such as safety appliances, first-class track and up-to-date bridges; (2) that there will be a hesitation in building new lines and throwing out branches. The consequences of the first may be reflected in increased accidents, the consequences of the second may devolve eventually on the shipper himself, by providing no increase in the facilities for the carriage of his goods commensurate with an increase in production arising from the opening out of new agricultural districts away from the railway, or by the establishment of new industries in remote situations. Affairs seem to be reaching this position in both Great Britain and America, and will undoubtedly do so in time in India also, where there has for a long time been a cry that it is difficult to raise capital for railway construction although the difficulty has been ascribed to other causes. In the former countries a remedy must soon be found in a general increase of rates, it being clear that the people can stand it as there has been a general rise in prosperity and in the standard of living. In India, when it is desired to punctuate the advantage of British rule it is also confidently affirmed that general prosperity has increased and people can now afford to pay more for luxuries, let alone necessities, than they could a few years ago. If, therefore, by an increase of rates in India the extension of railways would be facilitated it may be worth considering if it would not be advisable, since it is admitted that at the present time the expansion is a long way behind the needs of the country and the expansion is prevented by a difficulty in finding the funds.

ELECTRIC VACUUM CLEANING OF CARS OF BRITISH RAILWAYS.

By J. A. Seager.

The efficient cleaning of railway rolling stock as far as passenger accommodation is concerned is a problem which interests not only railway engineers but also electricians, inasmuch as in the latest developments electric power has been called into use very prominently in this direction. Considerable attention has recently been paid by more than one prominent British railway to the systematic development of their coach cleaning departments, with the result that we are enabled to refer to three important vacuum cleaning plants which have been developed quite recently. It may be said that portable vacuum cleaners while doing excellent work in locations where the number of cars to be cleaned does not warrant the installation of a permanent plant, must give way to the superior economy and efficiency in working of a permanently installed and sufficiently large stationary plant, to which the coaches to be cleaned can be directed.

The plants which we mention are installed respectively at the large new cleaning sheds which are being erected at Derby for the Midland Railway Co., the Bridgetown Cross Terminal Station at Glasgow, and the Northford depot near Edinburgh. In the first case the vacuum cleaner installed consists of a double acting slow speed double cylinder pump made under the Booth patents by the British Vacuum Cleaner Co., Ltd., of London. Its air capacity is over 40,000 cubic feet of air per hour and a 30 H. P. motor is required to operate it. The pump is water cooled, and is automatically lubricated. Four large filters are installed, these being of the dry type with bottom dust discharge doors connected up to the pipe line and plug cocks are fitted to each so that any one filter can be thrown out of service as required for emptying.

This plant, when operating at its full capacity is capable of working 20 cleaning implements at once, or in other words 20 cleaners can be employed to handle the train cleaning at the same time. At the Bridgetown Cross Terminal station which is one of the principal car cleaning and storage depots in the North British Railway Company's area, the vacuum machine is placed in a special building adjacent to the cleaning platforms and the air is carried by tubing along to the platforms 415 feet and 615 feet respectively. Eighteen nozzles in all have been supplied to each of which is fixed a flexible connection to the renovators or suction appliance. The main installation consists of a 16 H. P. electric motor driving a single cylinder horizontal vacuum pump of 20,000 cubic feet capacity, and two dust chambers each of 10,000 cubic feet capacity, and placed close to the pump house. It has been found that a compartment in the coaches can be cleaned in from 10 to 14 minutes and working with eight nozzles on carriages treated for the first time the average amount of dust removed is eight to nine pounds, by means of vacuum nozzles of either 2 ins. or 4 ins. in size. The 2-in. nozzles are used when the dust impregnation is very heavy and the vacuum requires to be concentrated over a small area, while the 4-in. nozzle is used for routine work on carriages which have been previously vacuum cleaned.

The North British Railway Co. has also installed a further cleaning depot at Northford near to their Edinburgh Station and close to a large carriage storage accommodation in connection with the railway extensions of their Portobello district. The cleaning shed is 110 yards long, provided with two docks and is capable of holding at one time ten of the largest cars running on the routes served. One island platform 9 feet wide and two side platforms 6 feet each are provided for the cleaners, while the vacuum plant consists of a plant of similar size to that described above in connection with Derby except that there are altogether 24 nozzles, the solid drawn enameled steel tubing passing along the back of two of the cleaning platforms for 350 feet.

It is expected that the lead given by the Midland Railway Co., and the North British Railway Co., will be followed by other railway systems in Great Britain and this application of electric power to the comfort and hygiene of passengers therefore deserves considerable attention.

Heard in the Outer Office.

THE SECRET OF BENTLEY'S SUCCESS.

While away from home recently, Harry Bentley met a friend of boyhood days. After cordial greetings, the man said, "Mr. Bentley, I hear that you are now at the head of the American Railway Master Mechanics Association,

and that you hold an important position on the Chicago & North Western Ry."

To this Mr. Bentley made one of his usual modest replies, and the friend exclaimed: "This is another proof of what I have always claimed, luck and cheek will carry a man anywhere."

JOE TAYLOR'S REPUTATION.

Some of Joe Taylor's numerous friends had the pleasure not so long ago, of contributing to a purse which was presented to him as a mark of appreciation for his work as secretary of the Western Railway Club. The presentation was made at an annual meeting of the club, on which occasion a number of gifted members extolled Joe's virtues, his courtesy, efficiency, kindness of heart, industry, etc., etc.

Naturally, Joe went home in a very happy mood. He exhibited the purse to his wife and from his retentative memory, he repeated many of the handsome things which had been said about him. After he was through, Mrs. Taylor with a twinkle in her eye, said: "Well, Joe, if the members of the Western Railway Club can say all that about you, it is plain that you must be leading a double life."

McGRATH'S PRESENT.

John T. McGrath, superintendent of rolling stock of the Chicago & Alton, was being congratulated by his friends on the receipt of a Christmas present.

"Yes," said Mac, "my uncle out in Tiffin is mighty good to me. The day before Christmas he sent me a check for $100, just as a Christmas gift."

After the usual congratulatory comments had been duly made all around, Mac added:

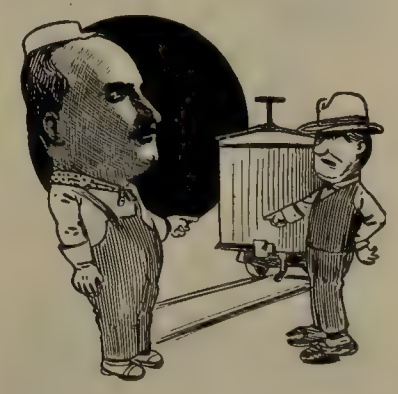
"Yes, he certainly is a fine old fellow. In the postscript of his letter containing the check, he said:

"'Dear John: If you manage to get this check cashed, pleased send me $4. I need a pair of shoes.'"

WILDIN AND THE GREEN BRAKEMAN.

George W. Wildin has been for several years a locomotive engineer. One day he took out a train on which an excessively green brakeman was making his first trip. The train stopped at a way station and the engine was cut off to take water.

When ready, the new brakeman arranged the automatic coupler and signaled the engine crew back to the train; at the first contact the coupling was made, but the new brakeman lifted the lever, signaled the engine ahead and tried the coupling the second time, which made all right, again the engine was cut off and sent ahead a few paces and back again for the third time. When Wildin with blood in his optic came down from his cab and exclaimed, "What's the matter young man you can't make that coupling?" "Well I'll tell you Mr. Engineer," says the new brakeman, "them iron things couple all right, but them rubber things hanging down below won't couple when you back up."



McKEE'S PAINT SPRAYER.

When George S. McKee was master mechanic on the Big Four at Mattoon, Ill., he was usually alert in the matter of special tools and progressive shop practice. About the time the paint sprayers were introduced in the railway paint shops the "Deacon" thought he would get in line before the other master mechanics and ordered his foreman tinner to make a hand-spraying machine, giving explicit instruction as to the method of construction. Now, this tinner knew more about

soldering seams than about pneumatic paint machines and made a mistake in the construction of the sprayer. He practically made an air tight cylinder instead of a sprayer.

Just about the time it was completed a visitor dropped in to see the "Deacon" who was anxious to exploit his new machine, so taking his friend over to the paint shop, he had the sprayer filled with truck color and started personally to spray the trucks under a coach. The foreman painter turned on the air but no spray. "A little more air," said the "Deacon." Still no spray. "Turn it on full." This was done and in about a second the sprayer exploded and the "Deacon's" new suit of clothes, including a new overcoat, were sprayed instead of the trucks. Since then the "Deacon" has personally inspected new devices before attempting to use them.

BOB PATTERSON AND THE CLOCK.

Robert Patterson, master mechanic of the Grand Trunk, took his daughter to the 1911 conventions at Atlantic City, and the latter, in the absence of her mother, took upon herself the responsibility of supervising Bob's actions.

One evening Bob was very late in getting in and his

daughter, who had been sitting up waiting for him, was quite severe in upbraiding him.

"Why, dear, it's not late," said Bob, but as he finished speaking a little traveler's clock owned by the girl struck three.

"You have told me a story, father. It is 3 o'clock and a nice time for a married man to be getting home," said the vexed daughter.

"There you go, dear, just like you to believe that old dollar-and-fifty-cent clock before you will your dear father."

MORGAN K. BARNUM'S ROOSTER.

Only Mr. Barnum's personal friends know that he is a great fancier of blooded poultry. Mr. Barnum is said to own a number of very choice chickens. Some time ago he had a rooster of fighting stock of which he was more than ordinarily proud. His last instructions to the help before leaving in the morning for his office were that this rooster be carefully kept from straying. One day the rooster did get away, and to celebrate the event, went into a neighboring yard and immediately declared war on the rooster he found there.

The second rooster was evidently also of fighting stock, for the Barnum rooster was defeated and was saved from

death only by the intervention of a foreign power in the shape of the hired man. The demoralized chicken was returned to his coop minus most of his distinguishing personality.

When Morgan K. returned that evening he was requested to kill a chicken for the family. He went to the coop and selected the scrummiest looking specimen he could find and chopped off its head. As might be suspected and as Mr. Barnum discovered next day, he had failed to recognize and had killed his favorite, the much prized head of the flock. Those who saw him that day say he could not have looked worse at the prospect of meeting a dozen grievance committees.

A TIME MONOPOLY.

An Irishman crossed the Canada on a Canadian Pacific steamer, took the Canadian Pacific train for Vancouver, ate at C. P. R. eating-houses, stopped at C. P. R. hotels, was shown C. P. R. land and finally got to Vancouver, much impressed with the greatness of the railroad

He went to a hotel, registered and asked the clerk how soon breakfast would be ready.

"Breakfast is over," said the clerk.

The Irishman looked at his watch. "It isn't time for it to be over," he answered.

"Oh, yes, it is," said the clerk. "You see your watch isn't right. We run our dining-room on Canadian Pacific time."

"Good Lord!" said the Irishman, in an awed voice, "does the Canadian Pacific own the time, too?"—Saturday Evening Post.

GARSTANG'S REQUISITIONS.

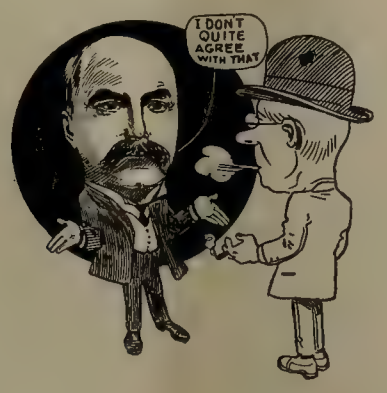
If there is any one official act that William Garstang enjoys, it is personal supervision of requisitions. And after he has endorsed the requisition, there is but little superfluous material ordered, as any master mechanic whoever worked for him can attest.

One master mechanic, Wm. Hassman, at the Huntington shops of the C. & O., usually protested the cutting of his requisitions and on one occasion, he said, "Mr. Garstang, you have a good shop here, good tools and plenty of them, and a good force. The only requisite we lack is plenty of material. You remind me of the man who was tied hand and foot and thrown into the river with the kindly suggestion that if he swam to shore, his life would be safe." Garstang smiled and Hassman got his material.

Another time when A. F. Stewart, still with the C. & O. was at Huntington, Garstang dropped in there with the requisitions and in going over them, he noticed what seemed to be an unusual order for monkey wrenches. He said, "Stewart, what on earth do you want so many monkey wrenches for? It looks to me like that amount ought to last six months. When I worked in the shop, a wrench would last me a year." Stewart smiled and said, "Mr. Garstang, that is the truth, but if the men working for us now at Huntington Shop, used a monkey wrench like you did when I was your gang boss, I think it would last them about two years." Garstang looked at Stewart as though he would like to know if he meant that Garstang was unusually careful or the other unduly destructive in the use of wrenches, but he didn't blue-pencil the order.

MR. MANCHESTER'S OBSTINACY.

While J. N. Barr was at the head of the motive power department of the Chicago, Milwaukee & St. Paul, Mr. A.



E. Manchester was reporting to him. Many differences of opinion arose between the two men and as they were both men of strong convictions, these arguments were apt to be fought out to a finish.

One day after a particularly important subject had caused the customary disagreement, Mr. Barr became much aggravated. Looking at Mr. Manchester in despair, he said: "Oh, well, if you were to fall into the river I would go up stream to pull your body out."

Little beds of flowers,
Little dabs of paint,
Make a railway terminal
Look like what it ain't.
—J. T. McGrath.

BRAZIER AND THE WEATHER.

While a car inspector on one of the eastern roads, Mr. Brazier was sent to Indianapolis to inspect some cars which had been leased and which were being changed to conform to standards. It was in the spring of the year and the weather in the Indiana town proved most changeable.

This proved most annoying to Mr. Brazier. If he went to the shops clothed in heavy raiment, with an overcoat, it was sure to turn out a hot day. On the other hand our car inspector was caught several times with light clothing in what he termed blizzards. To the amusement of his friends at the shops he finally turned up one morning in a linen duster, a straw hat, fur muffler and ear muffs.

DE VOY'S AGE.

As all who are well acquainted with Jim DeVoy know, the latter is given to rather careless statements as to his experience. Near his desk in the Milwaukee office a door opens into the drafting room. A person sitting just inside this door can easily hear all that passes in Mr DeVoy's

office. Mr. DeVoy has no secrets and the door is always open. After listening for years to Mr. DeVoy's various recitals of his experience, each with respect to a certain class of work, several of his co-workers started keeping track of these periods of industry which Jim credited to himself. Before Jim was made aware of the checking, notes were compared and by the assistance of the adding machine, it was discovered that to date Jim was 357 years old.

"The barber told me a very interesting story as he shaved me."

"Indeed!"

"Yes; and also illustrated it with cuts."—Santa Fe Employes' Magazine.

THE VALUE OF GOOD WROUGHT IRON.

By Chas. H. Reid.

At this time when railroad officials and manufacturers of steel rails are so deeply interested in, and recognize the imperative need of the production of a rail that will secure better protection to life and property, the occasion is opportune to suggest to boiler-makers, to manufacturers of locomotives and engines of whatever type, to mine operators and manufacturers of mine equipment, to superintendents of motive power, engineers of tests, and to those engaged in general forge and machine shop work, the importance of better knowledge of the character of the bar iron they need in their work. We say iron they need, for many are not using the iron they actually need, but to save something on the initial cost of material are risking the use of scrap products, or low grade soft steel, in work in which neither are perfectly safe or secure. In all the branches of manufacture or of railroad work, there enters the possible hazard to human life, either in the manufacture of the equipment, or in the subsequent security and long service of such equipment. To say that this hazard could be too completely eliminated; that a boiler could be made too safe; that a bolt or forging could be too secure, would be to invite not only criticism, but the unqualified censure of fair minded people, and yet chances against safety are taken daily by very reputable people, to save a few dollars on the first cost of material. We venture the assertion that there are very few long service men today in the mechanical departments of railroads; very few heads that have grown grey in service and have kept step in the procession; very few old-fashioned mechanics, that do not deplore the displacement of the puddled wrought iron in general use twenty years ago, with its easy working properties and better security,—by the uncertain scrap products and cheap steel substitutes that so many shops are using today. This is the age of steel, certainly so far as appertains to vast tonnage, to tremendous industrial and manufacturing enterprises and to construction and equipment in which quantity rather than quality is the essential.

Good puddled iron is just as essential and valuable today as in the past, and the recognition of its distinctive function in the mechanical and manufacturing world, is of more importance at this time, than two or three decades ago when its use was general, and its perfect security was known and recognized. It is more important today because the numererous uses found for metal products (uses for which the cheaper steel is all sufficient) have grown to such tremendous proportions as a tonnage proposition, that old fashioned bar iron has for a time seemingly been "lost in the shuffle." The consumer contracted the steel habit, as did many mills formerly addicted to bar iron, and the habit to both maker and user was strengthened by the assurances and confidence of steel makers, that laboratory practice would formulate soft steel to supply every mechanical requirement and quality possessed by good puddled iron. The claims have not been made good, and whilst habits are tenacious and hard to break, and many engineers and mechanics are reluctant to concede due merit to iron, particularly the generation that came in with soft steel—yet the number is constantly growing of those who frankly say that in various lines of special requirement work, and in locomotive and engine buildings, steel does not supply the security that naturally attaches to a first-class puddled iron. By puddled iron we mean a product of puddled Northern Grey Forge pig iron, and not the product of a mixture of stove castings, old grate bars, cast borings and swarf, which, when passed through the puddling furnaces and muck rolls, is largely sold to users as "puddled, all muck bar" iron, and guaranteed by the seller to be such. Technically, this can be called puddled bar iron, but any one at all familiar with metals, knows that the market value of the ingredients in the above mixture is only from one-half to two-thirds that of good Grey Forge pig iron; that it is cheap in quality as well as in price; that it necessarily must be of widely varying analysis; that the mere act of puddling and passing it through the muck rolls, cannot possibly make high class product out of low class material. The puddling furnace works no miracles. It will if charged with good stock and is properly handled, develop and refine the inherent properties of such stock, but it will no more return uniform reliable high grade product from low grade nondescript stock, than a weaving machine fed with shoddy will turn out broadcloth.

The puddling or boiling of pig metal today is but little different from the process of half century or more ago, and the design and operation of the furnace is practically unchanged. The furnace is simple in construction, consisting of a fire chamber, a chimney or stack equipped with a damper to regulate and control the heat and thus thickly covered with iron oxides. The object of puddling is to eliminate by oxidation the impurities and conflicting chemical agents remaining in the pig iron as it comes from the blast furnaces. The process includes the following steps:

(1) Making bottom for the charge, and "fixing" the sides of the working hearth, with ground ore made plastic by wetting to permit uniform coating, (2) charging the pig iron, (3) melting, (4) adding oxidizing agents to the bath, (5) agitating the bath by means of suitable tools, the puddling proper, (6) balling, (7) drawing, (8) and probably the chief in importance, the firing, which is continuous throughout all the other steps.

Without detailing all these steps, we will describe more fully some of the more important features. The skillful puddler is always a good fireman, and one who recognizes the importance of this operation. It is very important to fuse the whole charge as nearly at one time and at as low temperature as possible. This is accomplished by moving the broken pigs about with a suitable tool as they near the fusion point, thus exposing fresh surfaces to the flames and to the dissolving influences of the bath. This also protects the bottom by keeping it smooth, for the subsequent handling of the charge.

The time for adding the oxidizing agents varies; some puddlers charge them prior to the pig iron, others after the iron is melted, according to the preference of the management.

A large part of the silicon and some of the manganese is released during the melting, the oxidation of the manganese following closely upon that of the silicon, continuously until complete, except that the elimination of the silicon is checked when the bath attains high heat.

The boiling, or puddling proper, follows the melting, and consists of energetic stirring of the bath with a tool in the hands of the puddler, which results in the removal from the metal by oxidation of nearly all the carbon and most of the phosphorus and sulphur. The object of the vigorous agitation of the bath, is to bring the iron and cinder or slag into intimate contact to produce as uniform conditions as possible throughout the bath, and to prevent the iron from sinking to the bottom, and the cinder from rising to the top.

The second period in the boiling occurs when the temperature reaches a point high enough to effect rapid combination of the carbon of the iron with the oxygen of the slag. The carbonic oxide escapes in bubbles all over the bath, and very materially increases the heat and the volume of the charge. The bubbling out of this gas is alone an efficient agitator of the bath, if the work has been properly done but the puddler still keeps his rabble in use to prevent the superheated iron from settling on the relatively cold bottom in a partly refined condition.

The operation of the puddling is completed when the carbon has been so reduced in amount that the heat from its oxidation is not sufficient to hold the iron in a fused or partly fused condition, causing the "drop" of the bath or the settling of the grains of iron to the bottom of the furnace in

irregular clusters with the free cinder spread between the molecules. Besides the cinder enveloping each grain of iron, a considerable volume is contained in pockets in the clusters, the bulk of this is subsequently removed by squeezing and rolling. It is this free "high boil" requiring necessarily longer continuous labor to stiffen the mass naturally and uniformly, that distinguishes the puddling of pig iron, from the cheaper mixture referred to earlier, where borings are fed into the mettled material to thicken the mass and reach the balling period in less time and with less labor, but at the expense of quality and uniformity. If the process described has been skillfully carried through, all the iron is now uniformly ready, except that resting directly on the bottom, which with a final turn by the workman fits the whole mass for balling, from which stage it proceeds quickly through the squeezer and first rolling into muck bar. Proper cinder is vital through all the stages. Its composition is controlled by the added oxides, by absorption of some of the cinder bottom, by the character of the gases evolved by use of proper material, and by intelligent firing and regulation of the heat by damper. It is the presence of this cinder properly regulated, and the fibrous structure of puddled wrought iron, that gives it its distinctive value over steel for special requirements in all lines of mechanical work. It supplies sure welding properties not natural in steel; it provides a safeguard against shock, vibration, and extreme low temperature, that steel from its nature cannot assure. It facilitates easy forging at high temperature without risk of impairment of material or hardening to brittleness, and because of the glaze envelope of cinder about each fibre of good wrought iron, it will resist oxidation, and deterioration from outside exposure, that steel with its total absence of slag finds it impossible to resist.

For dredge, steam shovel, crane, and other special chains, it has no equal in steel. The government buys it for many purposes to the positive exclusion of steel for these purposes. Puddled pig iron in its best form is the only proper material for a locomotive boiler stay-bolt, and it is made right here at home equal in quality to any imported brand. It can be formulated to meet any mechanical requirement or specification at reasonable cost, and will make good a guarantee of uniformity and security that no mixed proposition or soft steel will do. Finally, if superintendents of motive power, and engineers of tests of the leading railway lines and systems would agree approximately upon safe and secure standards for special requirement irons such as stay-bolt, engine bolt, radial stay, boiler brace, center stems and spring pockets, and co-operate with mills in formulating irons to meet the needs completely at reasonable prices, much better protection and longer service will be secured, and the final cost will be less, in saved labor, cost of and loss of time in repairs, and scrapped material. As economy and efficiency have become watchwords, particularly in the manufacturing, industrial and railroad life of the country, and as popular sentiment is directing and shaping legislation, national and state, toward better safety, for both patron and employe, as well as property, the suggestion is timely, that discrimination as to quality and the security in good iron as well as to price, will fortify the watchwords of economy and efficiency and make them sure and vital.

Locomotive Fuel Economy

By Earnest Cordeal.

The fuel bill of the railroads, as has been frequently pointed out, is an item of great importance in that it composes from eight to seventeen per cent of the total operating expenses of the various great roads of the United States. This variation in ratio of fuel cost to operating expenses, as between various railroads, cannot be taken as an indication of the efficiency or inefficiency of fuel consumption nor can the fact that cost of fuel per locomotive mile fluctuates from eight cents to twenty-two cents be used as a comparative basis for determining the progress of the different roads toward economic use of coal or oil. The fuel problem is one which must be solved separately for each of an infinite combination of varying conditions.

It is true that the policy of the railroads' management as to the specifications for power purchase may to a large extent influence the size of the fuel bill. Wholely aside from the theoretical assumption that compounding and superheating are great factors in obtaining the maximum ton mileage with the minimum cost of operation, which question we hear constantly argued pro and con, stands out the fact that disregarding all influencing conditions the roads which employ a large percentage of compound and superheated engines show a lower cost on any desired basis than do the roads using exclusively simple saturated steam locomotives. It is not the purpose of this paper, however, to advance any argument favoring the compound over the single expansion engine nor superheated over saturated steam, as these are matters of administrative preference rather than a problem of operating economy.

The question to be determined by the rank and file of mechanical department officials is not whether they are provided with the very best equipment obtainable, but whether they are securing with the facilities at hand the utmost economy consistent with the best quality of service. Fuel experts are constantly calling our attention to the fact that coal consumption is entirely too high, some of them going so far as to say that forty per cent or more of the total cost of fuel might under proper conditions and competent supervision be saved. Let us say that twenty-five per cent of the total saving thus contemplated entails the employment of compound superheated locomotives, which it may be stated from a study of scientific tests and also from actual records in service is not an overestimate of what may be expected from the compound expansion and superheating of steam. The master mechanic in charge of a division has as a rule very little to say about the type of power which is given him, therefore he cannot be held responsible for the saving or loss of this twenty-five per cent. The question then arises as to what constitutes the items of loss composing the remaining fifteen per cent for which the inefficient use of steam is not responsible. It is not the intention to advance the positive statement that fifteen per cent represents the actual or even the approximate amount of fuel which might be saved on all roads through careful supervision, wholely aside from power design, on the contrary the figure is entirely arbitrary and though there is little question but that it is low enough to represent average conditions a much higher per cent would in all probability more nearly approach the actual loss in the majority of cases.

The determination of the actual fuel loss is a matter which must be localized to the greatest possible extent and only a minute study of each separate division and the performance of each locomotive assigned to the division will give dependable data. In order that such a study may be rendered possible it is essential that reports be rendered and records maintained which will insure the greatest accuracy possible and such reports should be available in immediate sequence with performance. A report or record of last year's or last month's performance is historically valuable, if correct, but its importance as a guide to improvement of present or future practice is extremely doubtful, while a report of yesterday's occurrence conveys information which may be used immediately with the best results. Reports as to fuel performance should then above all be immediate; secondly, they should be as accurate as if is practical to make them. By practical accuracy is meant the nearest approxi-

mation to the exact amounts of fuel consumed consistent with the measuring facilities provided. The weighing out of coal by the pound is all very well for the conduct of an exhaustive test. The test itself is of some little value in that it indicates what may be accomplished under favorable conditions and expert personal supervision. However, the only true data upon which to base rules of practice may be obtained by watching closely the performance of the average locomotive, handled by the average crew, under the average conditions of operation. The weighing out of coal in such case is as unnecessary as it is impractical. Any good system of measuring the tons issued to each locomotive averaging with sufficient accuracy to minimize the error occasioned by small amounts of overage or shortage.

Provided with records of the fuel consumption for each individual engine the first step toward effecting economy should be a detailed study of such records. To render such study of practical value it is necessary to consider the performance of locomotives by groups, each group being composed of engines of the same class in parallel service. Any comparison of data representing the performance of engines of varying design or in different clases of service has a certain value in determining the most economic type of power or the most effective speed and load factors, but is of little use to the division officials in locating and stopping leaks in the fuel account.

Having then divided the assigned power into groups of similar class in the same service, it will almost invariably be found that there is a very great diversity between the fuel records of the various locomotives in each group. Base the comparison upon what unit you like, preferably the gross ton mile, and it will probably develop that in each group there is a variation in fuel consumption between the poorest and the best individual engine record of fifty, seventy-five or even one hundred per cent. Immediately has been developed a fountain upon which to ground a sytematic investigation tending toward the location of inefficiency in fuel performance and providing a means of evolving a sytem of practice which will effect economy for that class of engine in that service. The engines in each group which make the best fuel record should be made the subject of careful study in order to determine wherein lies their superiority over other members of their class. When two locomotives of identical construction, employed in parallel service, show a wide divergence in the amount of fuel burned per unit of work done there must be an ascertainable reason. It will almost invariably be found that those engines which show the best fuel performance are notably good steamers, while those which mantain a high fuel consumption are as markedly poor steamers.

An engine may not steam properly for any one of a number of reasons, the inefficienucy of the fireman, imperfect draft arrangement, poor ash pan design, incorrect application of brick arch, grates unfitted to the class of fuel supplied or a number of other causes may be found responsible. When one engine of a class steams well and has a good fuel record, while another of the same class steams poorly and consumes more fuel, the two engines should be compared as to the details of draft appliances, grates, ash pans and arches to determine what changes should be made to improve the steaming qualities of the latter. If no differences are noted, to which could be attributed the delinquency of the poor engine, a change of crews for a few trips may develop the fact that the fault lay not in the engine itself but rather in its handling. The education of enginemen in the proper method of firing locomotives is a measure which should be intelligently and thoroughly carried out. No one system of firing can be cited which is the best for all classes of power or all kinds of fuel. The best method to correspond with a given set of conditions can only be determined by trial in actual service.

The advocates of thick firing, thin firing and medium firing, and the various one, two or more shovel systems have undoubtedly based their deduction upon the result of tests with a certain class of power, burning a certain grade of fuel, or have endeavored to arrive at a system which would give the best average results under all conditions. Almost any system of feeding fuel to the firebox when carefully worked out and followed will undoubtedly secure better results than no system at all, but the universal adoption of any one system will by no means insure the best obtainable results. The best method of determining the most economic firing system for any set of conditions is by closely observing the work of the engine crews who have been able to maintain the most creditable records rather than by making elaborate special tests of the various systems theoretically based. The locomotive engineer or fireman, while not a mechanical engineer nor having a speaking acquaintance with B. t. u.'s or caloric values, will, in the course of a few years' actual contact with the fuel itself, devise means of producing the best results with the minimum expenditure of effort, and it should not be considered as beneath the dignity of the seeker of fuel economy to learn from these men and to apply th practical methods which they have devised.

Practically all of the railroads in this country employ traveling engineers or road foremen of engines, men occupying these positions being selected from the body of engineers on account of their superior knowledge and experience, their duty being to instruct runners, old and new, in the best methods of operating locomotives. The creation of this position has proven itself to be a measure of great value in improving the quality of the service rendered by engineers.

The practice of employing traveling firemen to give instructions as to the best method of feeding fuel, while it has been tried with great success by some railroads, has not been generally adopted. There is little doubt that the establishment of such a position on each division would accomplish as probably no other method could, the education of firemen along the line of the best firing practices and would effect fuel economies which would in no other way be possible.

The man occupying the position of traveling fireman has an opportunity to observe the methods employed by all of the men on the division and, if he is properly receptive and possesses the ability to analyze cause and result, he will be able to determine what practice is the best and most economic for each set of conditions which come under his observation and will pass along the knowledge thus acquired to the betterment of the service as a whole.

Boiler foremen at the various points, if they can be induced to take an active and intelligent interest in the fuel performance of the engines under their care, may be of great assistance in effecting fuel economy. If the boiler foreman will carefully study the fuel records, he will know which engines of each class are making the best performance, and this knowledge will enable him to make comparisons as to the effectiveness of the various designs of draft appliances.

It is true that as a rule all engines of similar class will be equipped with identical appliances, that is when first put in service, under which assumption all these engines should be capable of the same performance. This idea, however, while theoretically sound is not practically true. It is unnecesasry to call the attention of practical mechanical men to the fact that locomotives of identical construction will show a wide variance as to the fuel consumption, while apparently all the details of design are the same on all. This condition merely emphasis the necessity of making an individual study of each locomotive in order to determine how the best results may be obtained in each case. It is not the intention to convey the impression that standards cannot and should not be established and maintained, but economy of fuel consumption should not be sacrificed to a blind following of these standards. Standard draft appliances for a certain class of engine, burning a certain fuel are very desirable, but each standard should only be established after careful study of practical results obtained upon the trial of the

various designs which will unvariably be advocated by the different mechanical men in charge of the power. Ever after the standard for a certain class of locomotive has been decided upon it will often be found that slight variations will improve the performance of certain individual engines and there should be no hesitancy in making such changes as will prove effective.

Records should be faithfully kept to indicate the peculiarities of each engine so that in the course of repairs at the various shops and enginehouses changes will not be made which will render her less efficient.

The arrangement of plates and nettings and the size of nozzle opening is too often left to the personal preference of engineers or foremen who, without a study of comparative results, conceive the idea that a certain arrangement and a certain size of nozzle represents the best practice. In fact as long as an engine is steaming well enough to keep off of the failure report, we are a little too prone to let it go at that instead of trying to determine whether or not the fuel performance is what it should be. This matter of drafting should not be overlooked as one of minor importance, as cases are of frequent occurrence where an improvement in these facilities will make a difference of twenty-five or thirty per cent in the fuel consumption of a locomotive.

Aside from fuel wastes, due to lack of education of fireman or neglect of proper attention to drafting, there are other items in which the fuel never goes into the firebox or is burned at such time as not to produce any energy available for handling trains. In riding over almost any railroad, and particularly one on which frequent sharp curves occur, it will be noted that the right-of-way is more or less strewed with lumps of coal which have been shaken from overloaded engine tenders. This overloading of tenders is apparently a very frequent and reasonless practice. It is very seldom that an engine arrives at the inbound enginehouse tracks without a surplus of several tons of coal over the amount required for the trip, and with even less frequency does an engine leave the terminal without a pile of coal in her tender extending above the sides. It is an easy matter to determine approximately how much coal is required to allow an engine to make the distance from one regular coaling point to another and allowing a fair surplus over this amount to provide against unforeseen emergencies, there is no reason why any fuel over this amount should be carried. If eight tons of fuel will take a certain train from one point to another there is no apparent reason why twelve tons should be piled on the tender, unless it is intended to supply the inhabitants along the right-of-way with cheap coal. The additional four tons will in all probability not be sufficient to enable the engineer to pass up one fuel station and the chances are that he will stop, and again the tender will be loaded to a sufficient height to scatter coal over another stretch of several miles of roadbed. The supplying of fuel to tenders should be handled on a system which would provide that each engine be given only such amount as would insure its arrival at the next regular coaling station. Aside from the fact that overloaded tenders cause more or less loss of fuel by shaking off, the supplying of a stated amount of coal for a certain run has an added advantage in that it provides an effectual gauge by which the engineer and fireman may know, not at the end of the month or year, but on each individual trip, how their performance is comparing with the record which is expected and should be attained.

At times when a system of limiting the amount of fuel issues has been suggested it has been opposed by certain officials on the ground that such a practice would cause more or less trouble on account of engines failing to make the next coaling station before the supply was exhausted, rendering it necessary to leave the train and run for fuel or cause a complete failure. If the system is carefully worked out and a sufficient allowance is made for emergencies, which does not mean extraordinary cases, such as wrecks or washouts, it will be found that trouble of this kind is of very rare occurrence.

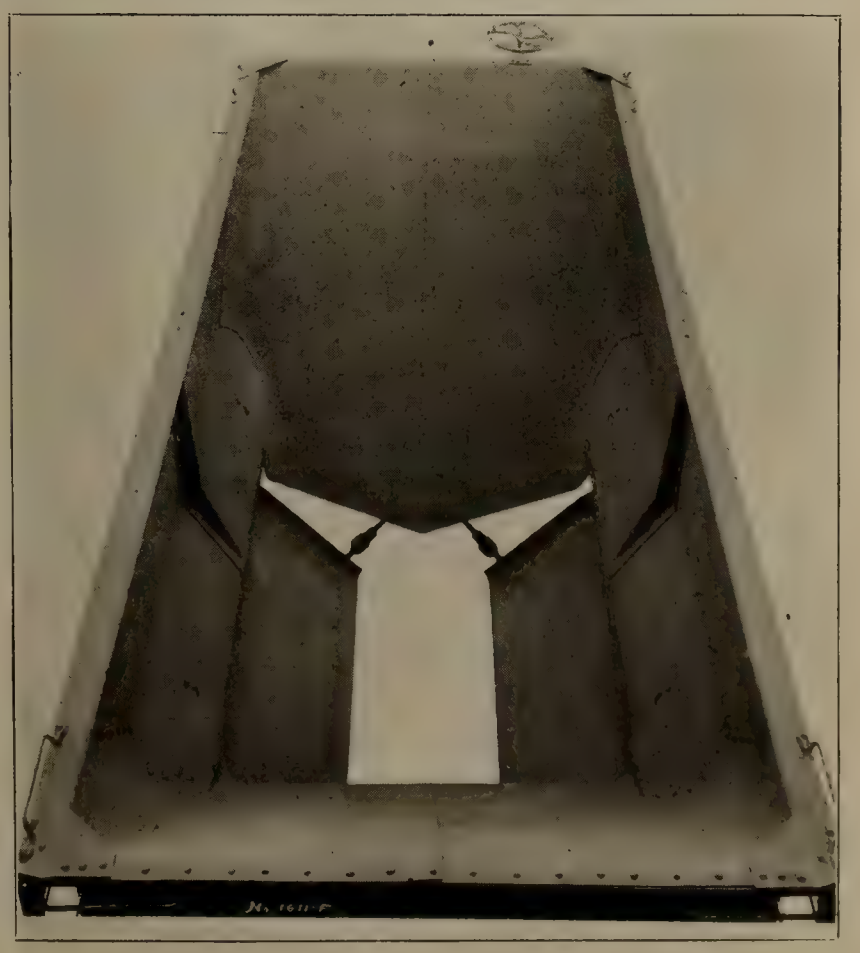
Another source of fuel waste which is of more importance than is generally conceded is that engendered by inefficient handling of locomotives at enginehouses. Due to inadequacy of dispatching systems, it often develops that engines are fired and held under steam for long periods before they are required for actual service and such fuel as is thus consumed is a dead loss. Under a proper system in enginehouses there is no excuse whatever for this practice. It should be known definitely just how long is required to fire a locomotive and develop the required amount of steam and such knowledge should be intelligently applied to the every-day handling of engines. The only excuse then for the use of unnecesary amounts of fuel in the enginehouse would be in cases where an order for power was cancelled or where unpredicted train delays occur.

In the foregoing there has been no attempt to discuss the fuel question as a whole, as this would involve starting with the mining or purchasing of the coal, tracing it through the processes of loading, shipping, storing and handling and could only end where each heat unit purchased had been fairly accounted for either as productive energy or as unavoidable loss. The only idea has been to bring to attention various points wherein mechanical department officials may effect savings of considerable amount in their fuel account.

SELF-CLEARING QUICK DUMPING ORE CAR.

The cars illustrated herewith were built by the Pressed Steel Car Company and were designed for use in the Northwestern ore trade, the primary object being to produce a self-clearing car which would discharge its entire lading between the rails practically instantaneously on opening the doors, without leaving any ore inside the car, which would have to be removed by digging, shovelling or other laborious methods, as is almost invariably the case with the ordinary type of drop bottom ore cars.

These cars have the largest unobstructed door opening which it is practical to obtain; the hopper floor sheets have a slope of 50 degrees and the hopper side sheets 60 degrees, insuring free and easy movement of lading. There are two doors, one hung from each side of car operated by an adjustable self-locking safety device, which is absolutely positive in its action and which will prevent the operator from



Quick Dumping Ore Cars, Interior Construction.

being injured through carelessness, or inexperience in operating the doors. The mechanism can be easily operated by one man and the time consumed in opening the doors, dropping the load and closing the doors again in actual service has been as low as one and one quarter minutes.

The doors are supported by cranks which turn over a dead center into a position of rest, so that no lead is supported by the gears or by ratchet locks. To dump the car the cranks are merely tipped over the dead center after

Quick Dumping Ore Cars, External Appearance.

which the weight of the lading sends the doors down with a rush and sufficient shock to materially aid in detaching lading which tends to stick to the inside sheets.

The doors are connected to the cranks by means of heavy rods with screw adjustment, whereby the doors may readily be maintained absolutely tight. There can be no stretch or give in these rods as is always the case in chain connection. This guarantees that the doors will stay tight and close and that there will be no leakage of ore in transit. Another advantage in this rod connection is that in handling frozen ore if the doors are frozen up so that they will not drop by gravity they can be forced down by means of these rods, which cannot be done with chain connections.

The doors have been made stronger and more heavily braced than has been the practice in the past to prevent distortion and damage from steam shovel loading under all conditions under which hard usage it is difficult to keep the doors in good shape and tight to prevent leakage of ore.

The crank shafts at either ends of the doors are equipped with segmental gears, connected by means of a "Rack Gear" along the side of the car, which insures perfect unison of action at each end of door both in opening and closing, also does away with the use of chains, as applied to some of the earlier cars of this type.

There is also an auxiliary latch which operates on the rack gear as an extra precaution to avoid accidental opening of the doors.

The general design of the car is in accordance with the best modern practice in car construction, every detail having been worked out with care to secure maximum strength and highest efficiency, and the distribution of material is such as to give lowest possible weight for safely carrying 50 tons of ore and providing necessary construction to make the car discharge its load freely. Material has been liberally used where necessary to insure that the car will run with a minimum cost for maintenance and operation.

The trucks used were of the arch bar type with 5½ in. x 10 in. journals, having pressed steel "Bath Tub" type bolsters and pressed steel brake beams.

The cars were equipped with 10 in. air brakes, friction draft gear, 5 in. x 7 in. shank couplers and safety appliances in accordance with Interstate Commerce Commission requirements.

The general dimensions, etc., being as follows:

Length inside of body	18 ft. 1¾ in.
Width inside of body	8 ft. 6½ in.
Width over side sheets	8 ft. 7 in.
Length over ends	22 ft. 0¼ in.
Height from rail to top of body	9 ft. 6 in.
Distance from center to center of trucks	14 ft. 8 in.
Length of drop door opening at center	5 ft. 7½ in.
At sides	8 ft. 0½ in.
Width of drop door opening	6 ft. 6½ in.
Cubic capacity level	705 cu. ft.
Cubic capacity—10 in. average heep	834 cu. ft.
Weight of car body	16,700 lbs.
Weight of trucks	15,800 lbs.
Total dead weight	32,500 lbs.
Ratio of paying freight to total weight of car when loaded	77.2%

Several hundred cars of this type have been in service on the D. & I. R. and D. M. & N. R. R. for over a year and have been giving complete satisfaction.

The Independent Pneumatic Tool Company will have a complete line of Thor air tools on exhibit at its booths, Nos. 587 and 589, during the Master Car Builders' and Master Mechanics' Conventions. Among the new tools exhibited will be the Thor roller bearing piston air drills, equipped with roller bearings on each end of the crank shaft, Corliss valves and one-piece connecting rods and toggles.

San Bernardino Precooling Plant

By C. M. Gay.

Precooling as relates to transportation is a term frequently misunderstood and misapplied. There is but little general experience in the art, and it has been confounded with cold storage and methods applied to static conditions from ignorance of its real application and significance. That it should appear as a complete, practical and efficient system applied to a whole trainload of loaded cars, with only the precursor of a few sporadic experiments applied to single cars, is a tribute to the inyention, careful design and engineering ability shown in the construction and operation of the great plant which this article describes.

It would hardly be necessary to elaborate upon the design, construction or operation of any cooling plant which by ordinary methods of refrigeration reduces the temperature of fruit or other products placed in refrigerating rooms for that purpose. All the conditions relating to such methods of refrigeration or cold storage are matters of common engineering knowledge and practice. But since the advent of precooling as a separate and distinct application of refrigeration to transportation has been recognized as an accomplished fact, it has become the fashion to dignify the old time cold storage process with the title of precooling plants, to escape the unpleasant inference and historical associations connected with cold storage proper, where the conditions are best suited to holding goods for a market rather than expediting delivery of goods to the market in the shortest time and best condition.

The term "precooling," properly applied, relates primarily to transportation and the immediate cooling of products within the refrigerator cars without re-handling and entirely apart from the idea of refrigerating by cold storage under ordinary practice.

There is no element of novelty in the cooling of perishable products in rooms where the ultimate object may be either that of reduction of temperature only or the indefinite holding for an advanced market. This is a cooling and cold storage function entirely within the discretion and control of the grower or shipper performed upon his own premises with no direct relation to transportation or transportation conditions.

On the other hand, precooling being performed within the refrigerator cars themselves eliminates all question of cold storage or holding goods for market, and by virtue of the fact that it is so performed necessitates speed, eliminating every factor of delay as a prime requisite of successful operation, *and therefore logically becomes a function which is a prerogative of the transportation companies, in the same manner that cold storage before delivery to the railway company is an unquestioned prerogative of the shipper.*

The element of time involved in the operation of precooling being one of prime importance in accelerating the movement and availability of refrigerator cars and equipment, furnishes a factor that fits exactly with the requirements of quick and efficient arrest of deterioration and decay in the fruit or other perishable products handled.

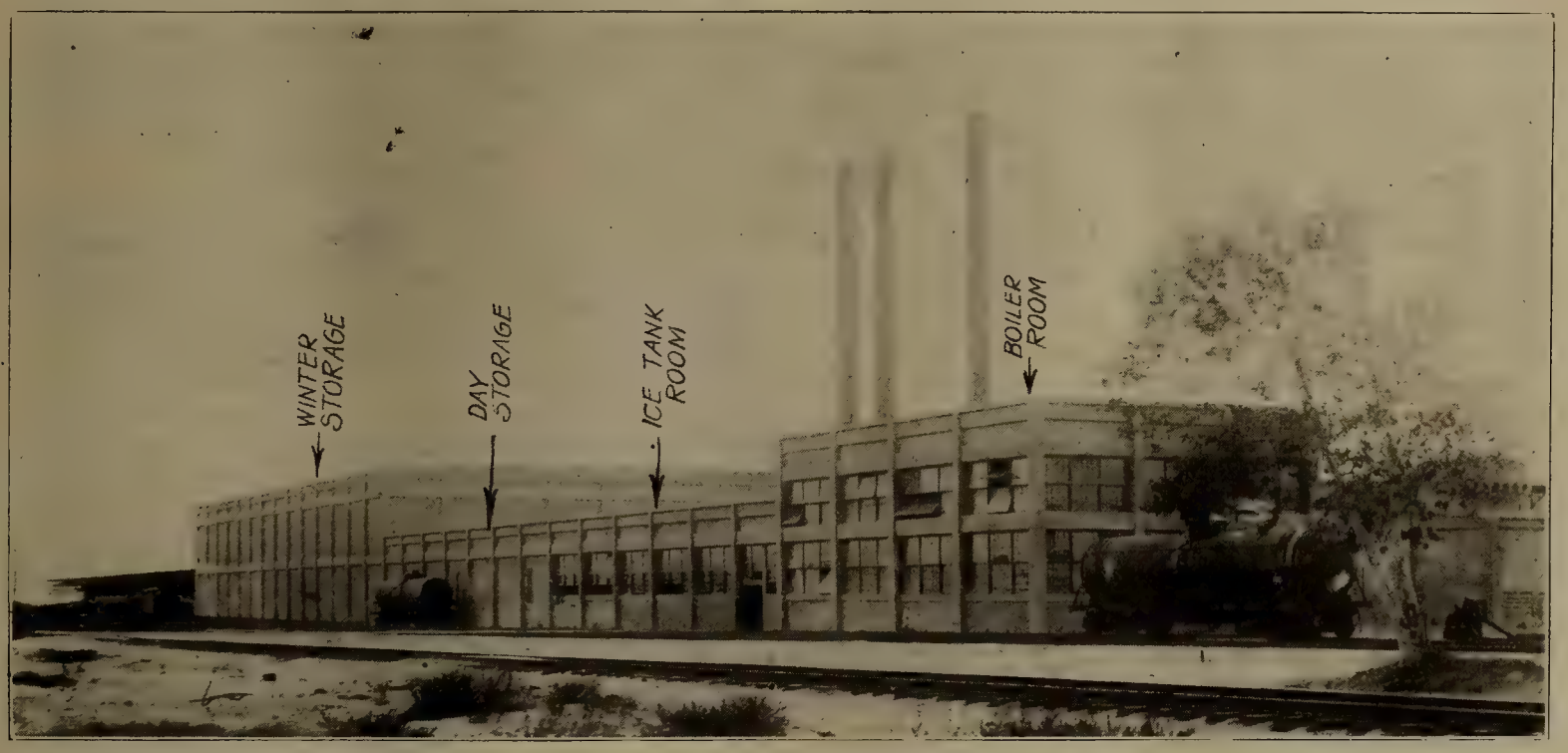


Fig. 1.—View of Plant at San Bernardino.

The concrete advantages of precooling may be summarized as follows:

Quick reduction of temperature to a safe point for transportation purposes.

Elimination of decay and deterioration.

Reduction of number of stops and switches for re-icing en transit.

Shortening of time schedules between producer and market

Avoidance of re-handling to and from storage.

Extension of market by lengthened radius of safe shipment.

Granting the desirability from the standpoint of both shipper and carrier of securing these advantages above enumerated, we are brought to consideration of adequate precooling equipment, cost and efficiency.

Santa Fe Plant.

Located in the center of the citrus fruit district, the Santa Fe plant has been in continuous service since its erection, early in 1910. Pick-up trains are operating throughout the entire San Bernardino valley, are taken to the precooling station as fast as loaded, and after a delay of about four hours, proceed to their Eastern destinations. Only occasional subsequent icing, filling the car bunkers, is needed en route.

General Plan.

The general arrangement of the plant is shown in Fig. 2, and an exterior view is shown in Fig. 1. The main building, comprising the power plant, tank room, day

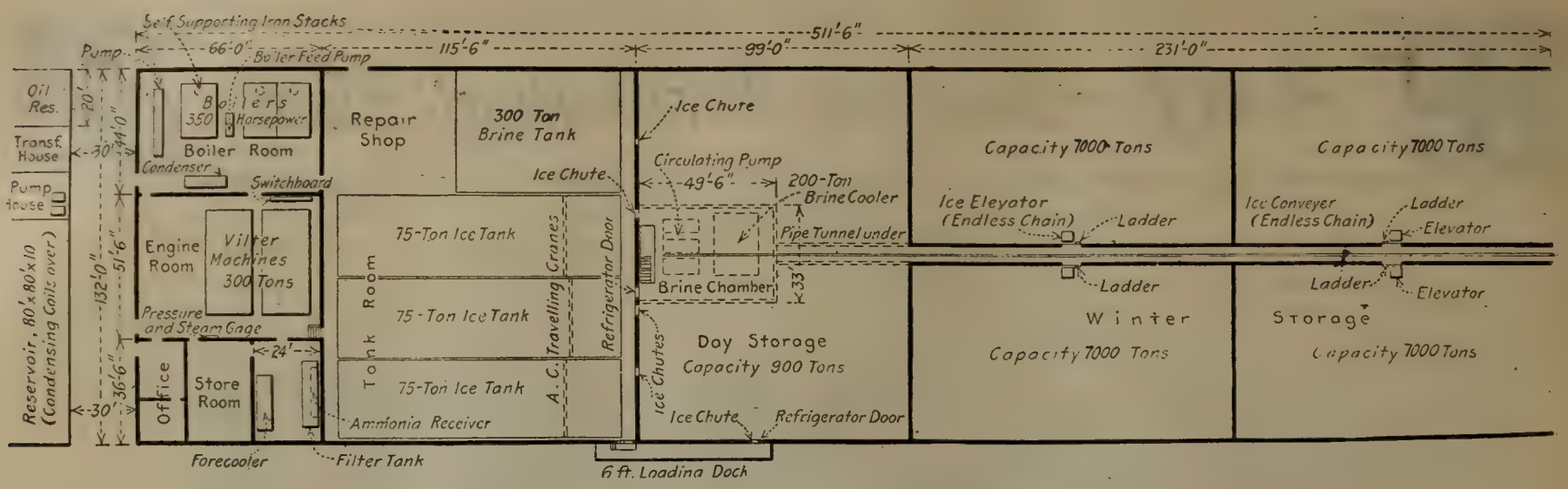


Fig. 2.—Engine and Tank Rooms Including Day and Winter Storage.

storage and winter storage, is 511 feet 6 inches long by 132 feet wide. Connecting to the winter storage, the precooler chamber and icing dock extend for a distance of 737 feet 6 inches, the icing dock proper being 693 feet long. This gives a full length of 1249 feet for the plant, or approximately one-fourth of a mile.

The structure is entirely of reinforced concrete with interior partitions and tunnels of the same material. The building may be considered as divided into two portions, one devoted to ice manufacture, the other to precooling. A reinforced concrete reservoir has been built, partially underground, 30 feet away from the powerhouse end. It is 80 feet square by 110 feet deep and is used in connection with an ammonia-condensing system of the two-coil double pipe type, which is placed over the front section of the basin coincident with the plant. Adjoining this a pump house has been erected supplying water for the ammonia condensing system, consisting of two circulating pumps, one steam and the other electrically driven. There is a transformer station on a line with the pump house, and a crude oil tank, 20x30x10 feet, has been constructed similar to the water reservoir and parallel to the boiler room.

Water for the system, including ice manufacture, is obtained from an artesian well, which is connected to the reservoir by a 14-inch steel pipe line. This is at the surface of the ground at the well end, and enters a measuring weir at the basin end approximately 4 inches below the edge of the reservoir, giving a gradient of but one per cent. The flow from this well furnishes a supply of 500 gallons per minute, the normal flow being increased to this extent by an air lift, for which purpose a 4-inch air line is placed in the same trench with the water line. The air compressors for this system are located in the boiler room.

Ice Manufacturing Plant.

The installation comprises three 350-horsepower Sterling boilers, set two in a battery and one single. These furnish steam to two 24x42-inch cross compound Vilter Corliss engines, each direct connected to one 300-ton, 17x34-inch duplex, double-acting Vilter refrigerating machine. Adjacent to the engine room is a 36x24-foot forecooler tank, filters and ammonia receivers, the latter being placed under the filtering apparatus.

The tank chamber is 115 feet 6 inches long, and extends across the full width of the building, having a ceiling height of 21 feet, with the floor line below grade the distance noted. The floor is of concrete, covered with 2-inch corkboard over which there is a finish of 1½ inch asphalt. Three 75-ton ice-making tanks are here installed, giving a total capacity of 225 tons. The cans used are of the regulation size, 11x22x44 inches, forming 300-pound blocks, and are handled three at a time by electrically driven traveling cranes. One 300-ton refrigerating tank is used for the precooling system and is equipped with a Vilter flooded-ammonia system of brine coils, with an accumulator.

Storage Plant.

The day storage room is supplied with five Stevenson recording double ice chutes, a Stevenson refrigerator door and the usual storage-plant auxiliaries. It has a daily capacity of 900 tons of ice, when blocks of 300 pounds each are placed on end in one tier. Figure 9 shows a typical view of the day storage.

The winter storage is divided into four compartments by 6-inch concrete partitions, giving a storage capacity of about 7000 tons for each such section. Each room in the winter storage is provided with an endless chain ice elevator for storing and having an iron ladder for access.

Adjacent to the wall separating the tank room and day storage, and below the floor of the latter, is a 49x33x11-foot brine chamber which is shown in the sectional elevation, Fig. 3. This compartment contains a 200-ton, two-coil, double pipe brine cooler and three electrically driven circulating pumps. The latter are interchangeable, two being used for the storage plant, or two for the precooling system, as the conditions necessitate; by this arrangement it was possible to omit a fourth pumping unit.

A concrete tunnel 8 feet wide leading from this cooling chamber extends through both storage rooms. At the end of the winter storage, the tunnel becomes a double-deck structure, the added section being of like size and construction as the lower duct, as will be noticed in Fig. 5. This lower tunnel is used for the brine mains running to the winter storage, and to the precooler coil chamber; the upper portion gives access to the winter storage and carries an endless-chain ice conveyor which leads from and through the day storage.

The entire storage plant, including the brine chamber, is insulated with 1½ inch double "Nonpareil" corkboard, with an asphalt finish of 1½ inches thick on the floors. The roof is

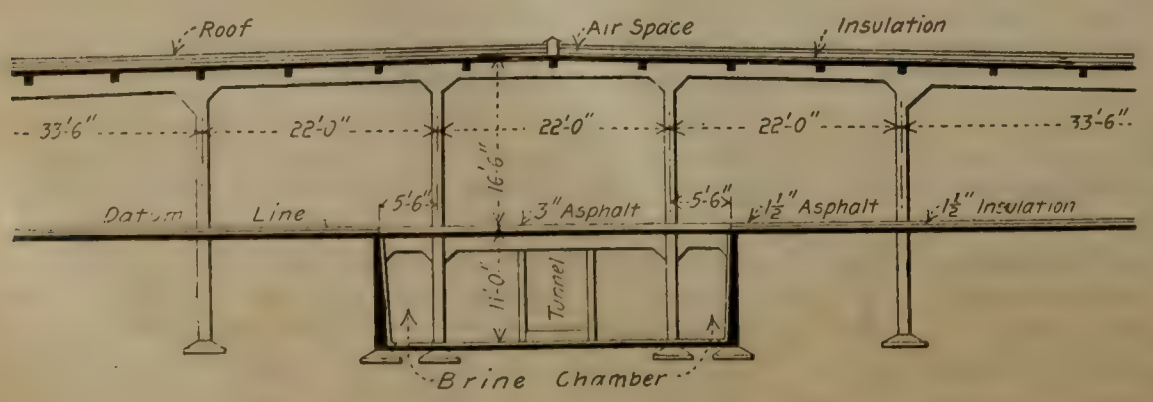


Fig. 3.—Section Through Day Storage and Brine Chamber.

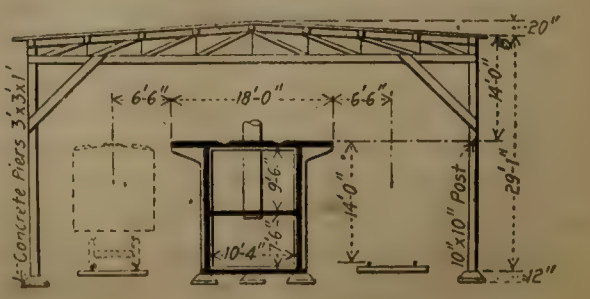
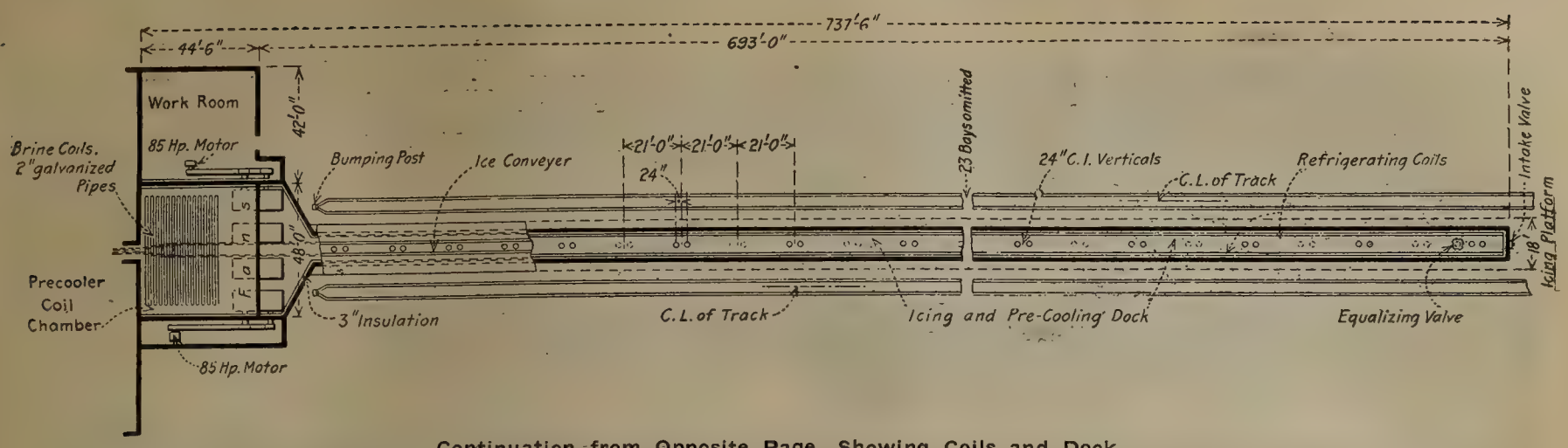


Fig. 4.—Precooler Air Duct.



Continuation from Opposite Page, Showing Coils and Dock.

insulated with "Linofelt" and air spaces. Neither room has any outside openings, all ice being handled through the day chamber and the central tunnel in the winter-storage room.

Precooling Plant.

The combined ice-making and precooling plant of the Santa Fe Railroad at San Bernardino, California, was designed and constructed under the direct supervision of Mr. C. M. Gay, of Los Angeles, California, and the precooling department was constructed under his patents with the advantages of careful engineering tests and data derived from his operation of the Santa Fe Experimental Station, where only one car at a time was treated.

The early experiments so conducted by Mr. Gay proved conclusively many engineering facts in regard to the condition of refrigerating cars and equipment, upon which were based inventions and devices peculiar to the system finally adopted. One fact stood out prominently, that all refrigerator cars were far from being air tight. Upon testing the cars after closing them as tightly as possible with an air pressure equivalent to one-half inch water gage, they showed a loss of air from unseen openings from 800 to 2000 feet per minute, and an equivalent vacuum within the car produced practically the same result in the amount of air drawn in from the outside. Consequently, in order to perform the function of precooling in an efficient manner and without great loss of refrigerating capacity, it was highly necessary that exactly as much air be withdrawn from the car as was being forced into it in the process of cold air circulation, and that the air circulating system must be so balanced, that the point of equalization between the pressure coming from the main pressure air ducts and the suction established in the main return ducts should occur as nearly as possible in the center of the car.

With this preliminary explanation a better understanding will be had of the following description and accompanying cuts.

Precooler Coil Chamber and Icing Dock.

Connected by the concrete tunnels, the precooler coil chamber adjoins the winter storage. It is 44 feet 6 inches long by 48 feet wide and is insulated with 3-inch corkboard. The installation consists of a brine coil of 2-inch galvanized pipe, supported by 4-inch channel uprights and small angle brackets riveted thereto. Eight double-inlet Sirocco fans, each about 10 feet in diameter, are arranged in two banks of four each. A set of four fans, two upper and two lower on each side, is driven by an 85-horsepower motor. One bank is used for blowing, while the other is for exhausting, each function being capable of execution by either set without reversing the direction of rotation. A horizontal concrete baffle, literally a floor, is placed between the two banks, as shown in Fig. 6.

Leading from the precooler chamber, two longitudinal concrete tunnels or air ducts extend to form the main support of the car-icing dock. These are 7 feet 6 inches and 9 feet 6 inches high respectively, and 10 feet 4 inches wide; both are of the same length, containing the full length, (693 feet), of the icing dock. The lower tunnel is the pressure duct, and the upper the vacuum duct, both being internally insulated with 3-inch corkboard. Refrigerating coils of 1¼-inch galvanized iron brine pipe are arranged on both sides of either duct, a total length of about 50,000 feet being required.

Connecting to these sections by liquid-sealed revolving joints, No. 18 galvanized iron pipes 22 inches internal diameter, serve as laterals to couple the system to the refrigerator cars. This is shown in Fig. 7, which affords a view of the icing dock arrangement. Figure 10 gives a view of the car icing dock which is additional to the precooling dock for icing of cars.

Electric System.

Purchasing electric current at high voltage from a central station, and stepping down to a voltage suitable for operation, the electric system offers no particular departure from ordinary practice; that is, the electrical energy is obtained at 10,000 volts and is reduced to 440 volts for motor operation, and again to 110 volts for a three-wire lighting system. The alternation of steam-driven and electrically driven auxiliary machinery, as previously indicated, permits of a continuance of operation should trouble occur at the central station.

Operation.

The plant has a maximum precooling capacity of 32 cars, 16 on either side of the icing dock, in every four hours, or approximately 150 cars every 24 hours.

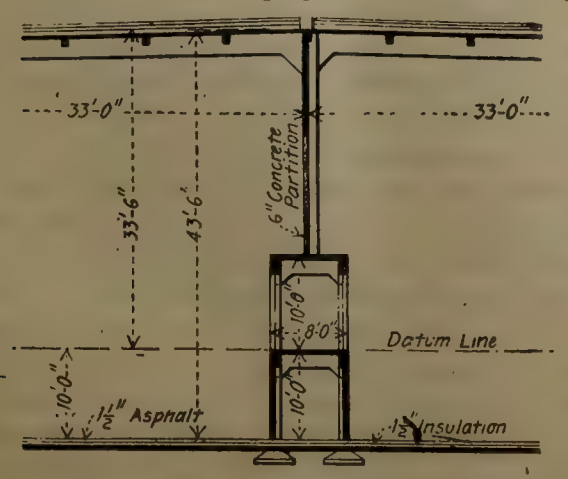


Fig. 5.—Section Through Winter Storage.

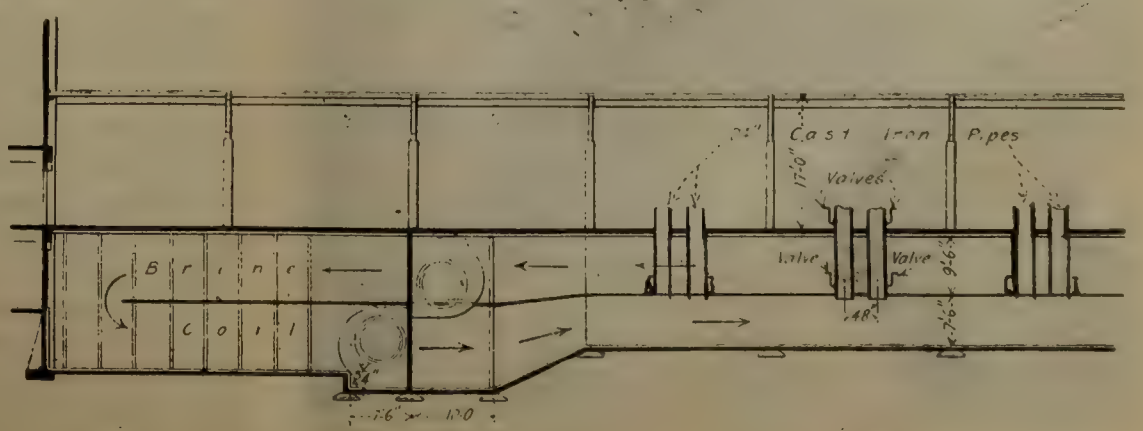


Fig. 6.—Baffle Between Supply and Exhaust Tunnels.

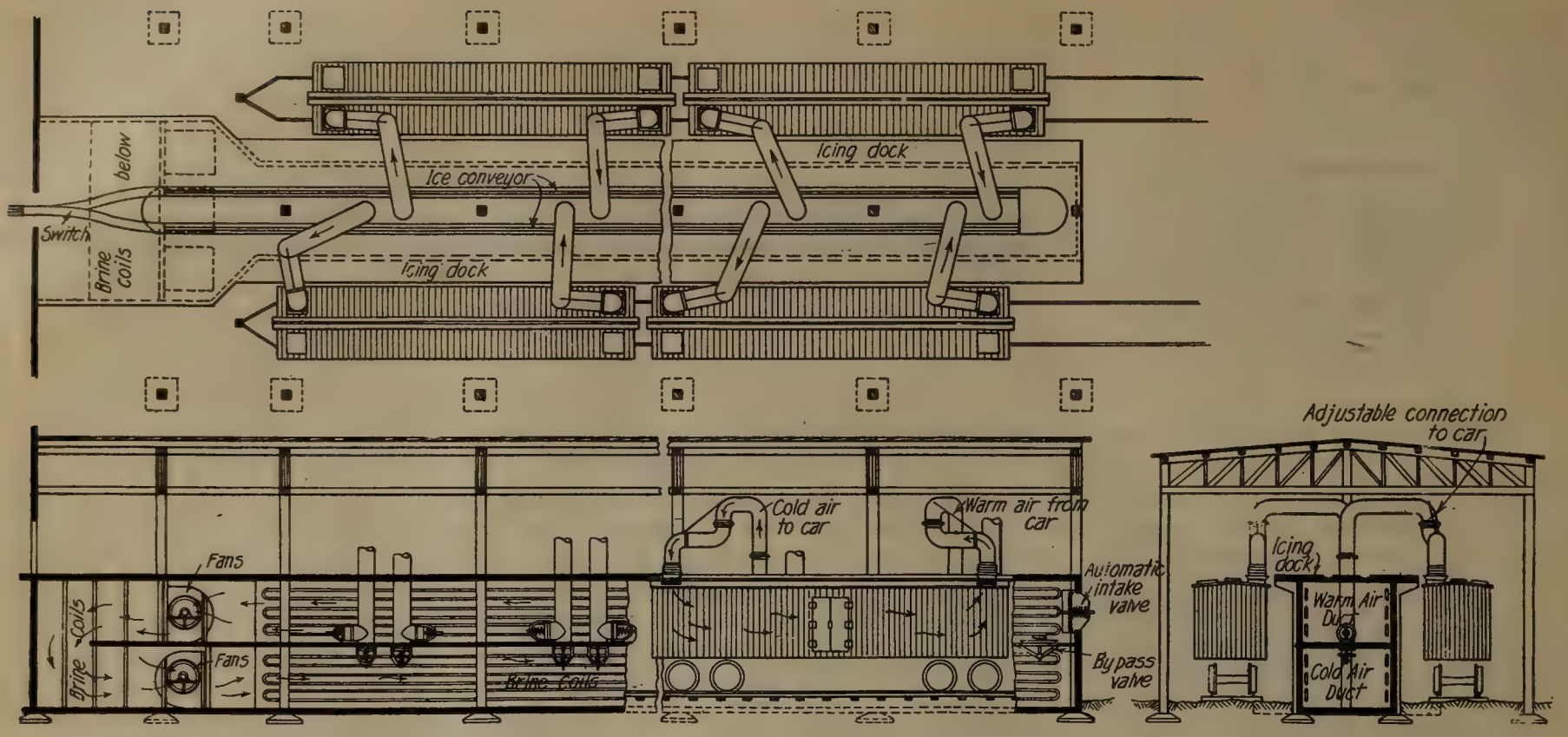


Fig. 7—Layout of a Gay Precooling System.

The brine is taken from the ice tanks by the circulating pumps in the brine chamber beneath the day storage, sent through its refrigerating circuit and returned to be cooled by the brine coils in the same compartment. By this refrigeration of the main ducts, the circulating air is kept in a similar state throughout its entire movement except when passing through the lateral connections to and from the cars.

A large automatic equalizing valve connecting the pressure and vacuum ducts is placed near the terminals of the tunnels. By regulation of this valve the pressure of the air delivered to the cars, and the suction at which it is withdrawn, are positively governed. The opening of this valve forms a by-pass whenever the differential pressure becomes excessive, thus permitting the air to circulate through the main ducts and main cooling chamber even when no connections are made for precooling.

An automatic intake valve is located at the extreme outer end of the vacuum or low pressure duct, as noted on the plan, Fig. 2, for the replacement of air which may be lost from the system by blowing the warm air from the cars. This is regulated to open when the vacuum falls below the differential pressure at which the equalizing valve is adjusted. The fresh air so taken into the system travels the full length of the suction duct, through the precooler coil chamber, and is then delivered to the high pressure duct to be distributed through the cars.

Fig. 8—View of Precooling Dock and 22-inch Air Pipes.

This insures the proper cooling of all air brought into the system from outside sources during the operation.

Referring to the fan installation, the upper bank is used for exhaust from the low pressure duct, delivering the air to the precooler coil chamber and thence over the brine coils. The other set draws the air from the coil chamber and discharges into the lower or main pressure duct for circulation through the system. The total air so handled is about 260,000 cubic feet per minute. The lower duct is held at a pressure corresponding to from ½ to ¾ inch of water above the atmosphere and the upper at a vacuum of ½ to ¾ inch of water. Accordingly, the air is supplied to the former at a temperature of from 8 to 10 degrees, and is returned through the latter at a temperature vaying from 20 to 24 degrees.

The fundamental principie of the Gay system is to secure a balanced circuit with the pressure above atmosphere in the pressure duct, practically equivalent at all times to the vacuum below atmosphere in the return on the suction duct. By this method a balanced differential air pressure directly at the ducts is obtained without the overcoming of any frictional resistance in the coil chamber. The point of equalization of the air current is thus rendered practically in the center of the refrigerator car whenever such connections may be made. Tests at the plant show that the differential pressures so equally balance during precooling as to allow the opening of the refrigerator doors, in the center of each side of the car, without any apparent loss of air to the outside, or the bringing in of any warm air, although a current of from 6000 to 8000 cubic feet per minute of cold air is passing through the cars.

Valves fitted to each lateral pipe, opening into both the pressure and the vacuum ducts as noted, secure the effect of cross connection and reversal of current, without any interchange of the laterals. These valves are of circular-disk type and of heavy construction. By employing the liquid-sealed revolving joints, universal horizontal adjustment is obtained for connecting the laterals to the refrigerator car openings. In this manner the union can be made to an entire train without uncoupling or spotting of cars, and regardless of their various lengths. The closing connection between the lateral air pipes and the cars is accomplished by a bellows spring and scissors-lever joint, comprised of leather and iron rings, operated by a crank, as may be seen by reference to Figure 8. This preserves the entire area of the pipe under any adjustment and makes the connection air tight almost instantly. The pipes themselves

are absolutely air tight, being externally insulated with two layers of ¾-inch hair felt, suitably covered. By means of the universal joints they swing free of the car track when disconnected. No telescope connections are employed in this system and no internal valves, the valves used being visible for constant inspection.

In connecting the cars in practice, a funnel is placed over the bunker opening and the pressure air duct is first connected to the car for about 20 seconds. The cold air rushing in quickly displaces the warm air and vapors which are allowed to escape through the ice bunker trap door at the opposite end. The lateral from the suction duct is then joined to the ice-bunker opening at this end of the car, and circulation is established. During the cooler seasons of the year both connections are made simultaneously. The differential pressures, of course, control the speed with which the air passes; the violence of the current permeates to the center of every package, which is an essential consideration in proper precooling.

The total amount of refrigeration consumed by a car of fruit averages about 3 tons, depending upon the initial temperature of the fruit, which, varying with the season of the year, may cause this amount to become as low as 1½ tons or as high as 4 tons of refrigeration. The amount of air circulating through each car in a period of four hours approximates 1½ million cubic feet. When the plant is running at maximum capacity

Fig. 9—View in Day Storage Room.

termissions the plant is given an opportunity to store up cold brine, placing it in a position to properly handle the large refrigerating demands made when a full load is incurred. The

Fig. 10—View of Car Icing Deck, San Bernardino Plant.

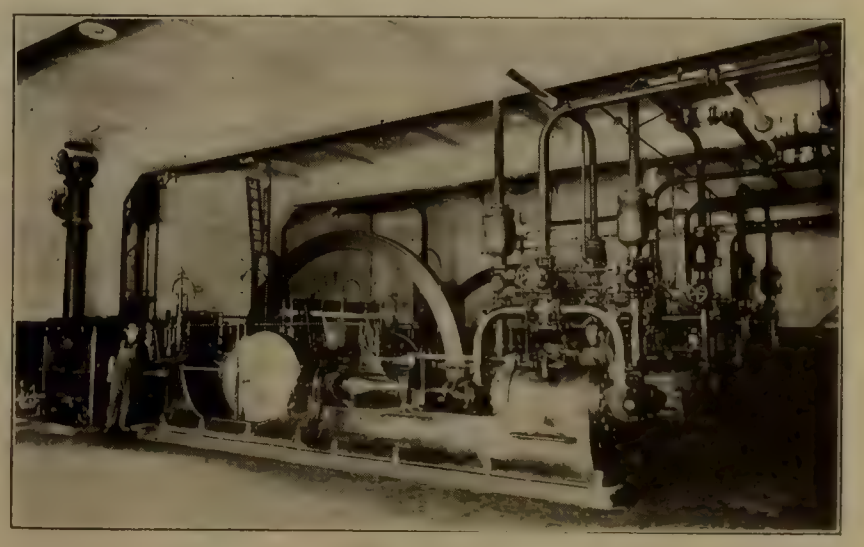
the amount of air circulated through each car per minute is about 8,000 cubic feet, with an average loss not exceeding 5 per cent. The cars are cooled to about 40 degrees Fahrenheit.

For icing the cars, upon the completion of precooling, or for such cars as are not precooled, the ice is handled by the endless-chain conveyor running through the day and winter storage. Here it may be diverted or carried on to the dock, the conveyor traversing the full length on both sides and making the ice accessible for immediate loading.

The plant is provided with facilities for metering all the brine used in precooling, and in cooling the ice-storage chambers, also with thermometers giving the temperatures at all such places. Barometric columns are installed in the main air ducts and laterals, showing the pressure at which the air is circulated and returned. To afford a complete refrigerating record on every car handled, the velocity of air in both feed and return laterals is measured.

A brine system of refrigeration has its advantages in precooling work. During the period of changing trains and other in-

original charge of ammonia at the Santa Fe plant was about 13,000 pounds and during its period of operation this has been added to but slightly.



Engine Room, San Bernardino Plant.

The plant represents an investment of about $900,000. The special features of the system installed are the combination of an ice-making and precooling plant in the same structure, the avoidance of loss of refrigerated air either by leaking out of the car, or by drawing outside air into the car, and the application to one or more cars at the same time with identical treatment, with the addition of effecting the precooling service without any alterations in the standard refrigerator car.

A feature of the operation of this system is the facility with which the cooling pipes are defrosted in the precooling system. The large quantities of humid air withdrawn from the cars in circulation results in an accumulation of frost upon the cooling pipes, which would in time frost the pipes together, so as to impede air circulation and refrigeration.

In this particular system the accumulation is comparatively slow, as compared with the amount of air circulated, owing to the fact that very little fresh air is ever drawn into the system in normal operation. However, some small degree of evaporation comes from the fruit itself in the short process of rapid air circulation in addition to the humidity of the contained air in the different cars, and in actual practice it is found advisable to defrost the coils at least once a week. This is accomplished by stopping the brine circulation and opening up four or five air laterals from the discharge or pressure duct to the outer atmosphere, when the great automatic equalizing valve will open under the suction from the fans, drawing the warm air from the outside, passing it over the coils and out of the discharge laterals.

With the brine circulation stopped and the warm external air being passed over the frosted coils and discharged again to the outside, it is found that one hour to one and one-half hours will completely remove the frost from the pipes and freezing surfaces.

The sewer connections, which are charged with calcium in the sewer trap, are then opened and the melted frost discharged at once to the sewer, after which the connections are closed and the cooling pipes are ready for another week's operation without requiring defrosting.

Another feature of the Gay patents is the arrangement for utilizing the precooling connections as preheating connections during severe cold weather. These are not installed or required at the San Bernardino plant, but will be installed in such precooling plants as are located where the winter temperatures are very severe, operating the cooling pipes with warm brine, producing a higher temperature of air to be circulated through the cars in exactly the same manner that the low temperature of air secures precooling.

Societies and Associations

AIR BRAKE ASSOCIATION.

The nineteenth annual convention of the Air Brake Association was held at the Jefferson Hotel, Richmond, Va., May 7-10, W. P. Huntley, general foreman of the Chesapeake & Ohio at Ashland, Ky., presiding.

After the opening exercises a paper on "The Job Behind the Cleaning Date," by C. P. McGinnis, was read by his successor on the Soo Line, H. A. Clark. It relates to the remarkable results accomplished by Mr. McGinnis, in the past two years, in improving the air brake service by careful inspection of the freight brake equipment, systematic testing and cleaning of triples and brake cylinders, and the providing of proper facilities for the purpose.

In the discussion the Pennsylvania method of testing the leakage of brake cylinders by gage and limiting the leakage to 5 lbs. per minute was generally commended; this practice is extending to other lines and its general adoption was strongly urged. It is difficult to comply with federal laws relating to air brakes and maintain 85 per cent of the brakes on a train in good order without a well organized system of tests and inspection.

W. V. Turner, of the Westinghouse Air Brake Company, gave an illustrated lecture on Recent Air Brake Developments. It dealt more particularly with the improved brake for light and loaded freight cars, and excited such unusual interest that this brake equipment will probably come into more general use.

In the discussion, C. C. Farmer described the successful operation of this system on the Bingham & Garfield in the copper region of Utah. Here 40 loaded cars weighing 3,040 tons are handled safely on a 16-mile grade, 3.2 per cent maximum. The operation of the trains was one of these most difficult problems encountered by the air brake company. This equipment has also been applied to 500 cars on the Denver, North Western & Pacific, and there are a few in use on the Santa Fe, the Baltimore & Ohio, and the Southern Pacific. Representatives from these lines reported it working successfully and without any unusual difficulties. On account of its great advantage in increasing the percentage of brake power to the weight of the train it is expected that the use of this brake will extend to lines in level districts as well as on the heavy mountain grades, and it will be especially useful on 50-ton coal and ore cars.

A committee report on this subject, "Air Hose Failures," presented by T. W. Dow, chairman, directed attention to the great increase in the bursting and blowing off of the hose from the fittings. Careful observations on a large railway during the past summer indicated that these troubles are worse during the hot weather than during the winter months. While a number of suggestions have been made as to why the difficulties with air hose have increased so greatly during the past few years, there seems to be little question but that it is largely due to the use of poor and inferior material. There is also no question but that a good grade of rubber could be supplied if the railways were willing to pay a higher price for the hose. It was suggested that the Master Car Builders' specifications were not severe enough and should be revised. Also that far better results would be obtained by buying the hose on a service basis rather than on specifications which make no reference to the service results which must be obtained. A considerable amount of trouble is experienced because of frozen or stiff hose, and it is believed that this could also be remedied by using better material. In order that prompt and effective results may be obtained in remedying these difficulties it will be necessary for all the roads to work together as a unit, and it was suggested that the Master Car Builders' Association take some step to bring this about.

The principal interest in the discussion was attached to the quality of the hose. In passenger service, with long cars and short cross-overs, there is such a large lateral movement of the car ends that the hose is pulled off, even with proper holders which provide for a free lateral movement. Some lines limit the service of passenger brake hose to six months, and it is then used in freight service; others make a longer limit and then scrap the hose entirely. They also test the hose on passenger engines with soap suds daily.

The northern lines still have trouble from rigid hose in very cold weather, and it is often necessary to remove hose from freight cars after six months' service in severe winter weather. The inferior quality of the rubber, especially that in the inner tube, was discussed at length, and it was generally admitted that the price usually paid was too low to secure rubber of good quality.

The M. C. B. specifications should be revised in several

particulars, especially in requiring a high tensile strength for the rubber, so as to more effectually exclude poor rubber. Metallic coverings for air hose were approved by some, and by others it was even suggested that a complete metallic flexible coupling be used for passenger cars instead of rubber hose. Considering the short life of rubber and the expense for hose of good quality, it is possible that a metallic pipe union would prove economical in the end. Attention was directed to the importance of storing hose in a dry place where the temperature is not too high.

J. W. Walker read a paper on "Undesired Quick Action of Freight Triples" in which he analyzed the cause of the trouble known among trainmen as "kicker," "snapper" and "dynamiter," due to the emergency application when service stops only are desired. The numerous causes of the abnormal action of the triple because the auxiliary reservoir pressure cannot reduce as fast as the brake pipe pressure falls, are listed below:

Weather conditions:
  Unequal expansion of different metals.
  Freezing of moisture.
  Gumming up of excess lubricant.
Lubricant:
  Too heavy.
  Too much used.
Feed valve:
  Sluggish.
Engineer's brake valve:
  Condition of—
    Preliminary exhaust port too large.
    Equalizing piston:
      Dirty.
      Gummed up.
      Tight.
    Conical end of piston stem filed off.
    Removal of exhaust fitting.
  Manipulation of—
    Lap, allowing brake pipe leakage to
      Apply brakes.
      Open graduating valve.
    Partial emergency position used for service.
    Too light preliminary reduction.
Equalizing reservoir:
  Leaky.
  Volume reduced by water, etc.
  Too small.
  Choked passage between equalizing piston chamber and equalizing reservoir.
Brake pipe:
  Leaky.
  Long.
Conductor's valve:
  Attempted service application with.
Triple valve:
  Restricted service port in body or passage to brake cylinder.
  Restricted service port in slide valve.
  Dirty.
  Gummed up.
  Excessive friction of slide valve.
  Tight piston.
  Restricted feed groove.
  Piston makes tight seal on bush.
  Gum on piston bevel.
  Graduating valve spring catching in bush.
  Weak graduating spring combined with excessive friction.
Piston travel:
  Short.

Most of these causes can be removed if the brakes are properly maintained. The paper describes a device for locating triples which produce undesired quick action, the invention of C. L. Courson. It consists of an indicator placed between two hose couplers, so as to couple in the train line. When several of them are placed in a train line and brakes are applied, the needle on all the indicators will point in the direction from which the quick action started, and by a process of elimination the defective triples are located.

It was generally agreed in the discussion that the use of dry graphite as a lubricant for the triple slide valve was the best remedy and has overcome most of the trouble so far as it relates to the triple itself.

R. C. Augur, engineer of tests, American Brake Shoe & Foundry Company, read a report on "Friction and Wear of Brake Shoes as Affected by Wheel Load." The paper gave an interesting historical account of brake shoe tests and of brake tests. It showed the loss in efficiency by increased brake shoe pressure and included diagrams illustrating the present conditions in express passenger service. The author proposed a rational sliding scale for proportioning the braking power. He said in part:

"The time has come when a sufficient mass of positive and usable data have been accumulated to enable us to say that the method used for so many years of proportioning braking power on passenger cars to 90 per cent based on a brake cylinder pressure of 60 lbs. is no longer tenable and must become obsolete in the immediate future. Even though our methods have given good results in the past under other conditions, the situation today has so changed that the practice must now be made to agree with known facts. If we wish to operate our passenger trains with smoothness and safety we must adopt a rational sliding scale for proportioning the braking power.

"In all of this discussion we have not referred to the acknowledged advantage of having the emergency braking power in excess of that used in service application. This difference is desirable on all weights of cars, but is of increasing importance with very heavy equipment. What we have desired to emphasize is that the braking power should be proportioned in accordance with the laws of brake shoe friction and that this calls for increasingly higher percentages of braking power as the car weights are increased.

"While the subject of brake shoe friction is a vital one in connection with the design of car brakes, the rate of wear of brake shoes is one that is ever with us, as it affects operating costs. In the effort to obtain increased durability and consequently reduced costs, there has been a marked tendency on the part of many roads to use shoes of rather low frictional properties, not realizing that the saving is more apparent than real. On the other hand some of our largest systems appreciate the fact that brake shoes are used to do work, that other things besides durability are essential and that they are not applied simply as ornaments or to permit cars to be interchanged. If the work is done shoes will wear out and all that we should ask is that they render a good return for the investment. It is not the part of wisdom increase the braking power so that good stops can be made for a road to apply the latest improved brake mechanism and

The paper closes with a discussion of brake shoe wear. Mr. Walker believes that we are going beyond brake shoe pressures which are good practice and mentioned experiments which are being made with clasp brakes which may have an important bearing on future practice.

The paper was discussed at length by S. W. Dudley of the Westinghouse Air Brake Company, who showed that while 90 per cent of the brake power was applied to the shoe only 10 per cent was realized in efficient work in stopping the train, and the principal loss was due to the brake shoe. The co-efficient of friction which is usually only 10 to 12 per cent in passenger service, was the real measure of brake efficiency

and some improvement should be made in the methods of brake shoe application to increase this efficiency.

W. L. Burton, of the Westinghouse Air Brake Company, then described verbally the clasp type of foundation brake gear for heavy passenger cars, and presented drawings of such gear as applied to four and six-wheel trucks on the Philadelphia & Reading. This gear has been in successful use on that road for about two years, and a service of 12,500 miles per brake shoe is obtained. The total leverage is 9 to 1, and as the usual load on the brake shoe is divided by two the wear is reduced and there is much less heating of shoes than where only one shoe is used per wheel.

W. V. Turner regarded these two papers—that of Mr. Augur and of Mr. Burton—as so important that the subjest should be followed up, and it was decided to appoint a commitee to further develop the proposed improvements, and report next year.

Thomas F. Lyon, of the Lake Shore & Michigan Southern, read an extensive paper on "Westinghouse PC Equipment," in which he brought out the results obtained from the PC equipment in road service in the past few years, and explained in a general way the proper methods of train handling and the care and maintenance of the equipment. In closing he said:

"In conclusion it can be said that the PC equipment has fulfilled all the requirements laid down after the Toledo tests by the air brake supervisors of the New York Central lines, and also that it does accomplish what was required by the railroad conference held in Pittsburgh in 1909.

"It is essential, however, that the truck and foundation brake gear be of such a design as to withstand the enormous pressure developed by the PC equipment. If this is done, it will only be necessary to state what stopping distance is required above 800 ft. at 60 m. p. h. in order to have it accomplished. As the matter now stands we cannot be sure whether the forces developed are being applied properly or not; that is to say, the trucks tilt, changing the weight on the wheels more or less, the springs are pulled down together, there is longer piston travel, and in various ways the forces are distributed in a detrimental manner. This, of course, largely defeats the object and may result in abnormal stresses in the train, flattening of wheels, etc.

"There can be no question but that the PC equipment will meet all the requirements of service braking and develop all the force required for emergency; but for these features to operate effectively, it is essential that it should have the proper foundation to work upon, and for this, it is not out of place to ask this association to put forth its best efforts to secure such truck and foundation gear design as will meet the requirements."

The discussion related principally to the manner in which the engineers reduced pressure in applying the brake when the PM and PC brakes were mixed in a train. Much of the difficulty from the flat wheels was due to improper application, and in not carefully following the instructions for the use of these brake equipments.

P. H. Donovan read a paper on "Pipe and Pipe Fittings," which related more particularly to the air brake piping on locomotives. It gave the results of an exhaustive investigation made by the Westinghouse Air Brake Company to determine the effect of elbows and pipe fittings on the service operation and quick action of the brake. It was shown that the ordinary data relating to air transmission in pipes does not apply to brake operation and is misleading if so applied. To secure proper brake action the pipes and fittings must be such as will insure a drop of pressure in the brake pipes at the rate of 8 lbs. per second.

Brief addresses were made by J. F. Walsh, general superintendent of motive power of the Chesapeake & Ohio, and J. E. New of the Norfolk Southern.

The following officers were elected: President, H. A. Wahlert, Texas & Pacific; first vice-president, W. J. Hatch, Canadian Pacific; second vice-president, L. H. Albers, New York Central; third vice-president, J. T. Slattery, Denver & Rio Grande; secretary, F. M. Nellis, Westinghouse Air Brake Company; and treasurer, Otto Best, Nathan Manufacturing Company. St. Louis was selected as the place of meeting for next year.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

The sixth congress of the International Association for Testing Materials will be held in the Engineering Societies Building, 29 West Thirty-ninth street, New York, during the first week of September, 1912. On Monday of that week, September 2d, the headquarters will be open all day for the registration of members, acceptance of the credentials of delegates, assisting foreigners and strangers to the city to secure lodgings, etc. In the evening there will be an informal reception under the joint auspices of the American Society for Testing Materials, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers. On Tuesday morning the congress will convene at 10 o'clock, at which time there will be an address of welcome by the Acting President of the International Association, Dr. Henry M. Howe, and by National, State and Municipal Officials.

The various sections will then arrange for their sessions in their respective section rooms. The papers for presentation at these sessions are now being printed. The proceedings of the congress will be conducted in English, German and French, with the aid of competent interpreters. The section sessions will convene at 2 p. m. and continue until 5 p. m. The evening will be left free for the visitors to get settled and become acquainted with their localities. On Wednesday section sessions will take place from 10 to 12 a. m. The afternoon and early evening will be occupied by an excursion to West Point. On Thursday there will be section sessions beginning at 10 a. m. and 2 p. m. In the evening there will be a reception tendered by the American Society of Civil Engineers in its building at 220 West Fifty-seventh street. Owing to the limited capacity of the building this reception will be restricted to the foreign members and delegates and to a number not exceeding 400. On Friday there will be section sessions in the morning and early afternoon, and an evening excursion down the harbor. On Saturday morning at 10 o'clock there will be a general session at which the sections will report, and resolutions upon their recommendations will be passed. The congress will adjourn at noon. The evening is reserved for later arrangements.

MASTER BOILER MAKERS' ASSOCIATION.

The sixth annual convention of the Master Boiler Makers' Association was held in Pittsburgh, Pa., May 14 to 17. The first session was called to order by President George W. Bennett. The address of welcome was made by Charles A. O'Brien, the attorney for the city of Pittsburgh, who represented the mayor. L. H. Turner, superintendent of motive power of the Pittsburgh & Lake Erie, spoke of the responsibilities and duties of the boiler shop foreman. T. W. Low, vice-president of the association, responded. William McConway, of the firm of McConway & Torley, gave some reminiscences of the early days of the city and its transportation facilities. George Wagstaff responded to Mr. McConway. J. F. Deems spoke of the work of the foreman and urged that far more could be obtained from men by kindly treatment than in any other way. There are very few men who will not respond to kindness, and when such a man does get into a shop it is well to get rid of him in the shortest possible time. The response to Mr. Deems was made

by W. H. Laughbridge, the chairman of the executive board of the association. The closing address of the opening session was that of the president, who dealt with the progress of the association and its affairs.

The treasurer's report showed the association to be in good financial condition, with a cash balance of $391.77; the total membership in good standing is 218. The registration of the first day showed an attendance of 266 men and 131 ladies. A letter was read from the International Society for Testing Materials inviting the association to send a representative to the sixth congress, which is to be held in New York in September. Charles P. Patrick was elected to represent the association. An invitation was also received from the Third National Conservation Congress, asking that the association send five delegates and five alternates to the convention in Kansas City, Mo., in September. The invitation was accepted.

The following officers were elected for the coming year: President M. C[illegible], general foreman boiler maker Chicago [illegible] Western, first vice-president [illegible] Rowe, general boiler inspector, Canadian Pacific, second vice-president James T. [illegible], assistant general boiler inspector, Santa Fe System, third vice-president Andrew Green, general foreman boiler inspector, B[illegible] Four; fourth vice-president, Dan Lucas, general foreman boiler inspector, Chicago, Burlington & Quincy; fifth vice-president, John Tate, general foreman boiler maker, Chicago, Milwaukee & St. Paul; secretary, Harry D. Vought, New York; treasurer, Frank Gray, foreman boiler maker, Chicago & Alton. For members of the executive committee: B. T. Sarver, foreman boiler maker, Pennsylvania; A. Lucas, foreman boiler maker, Chicago, Milwaukee & St. Paul; W. H. Laughridge, general foreman boiler maker, Hocking Valley.

It was announced that Chicago had been chosen for the next place of meeting.

RAILWAY STOREKEEPERS' ASSOCIATION MEETING.

The ninth annual convention of the Railway Storekeepers' Association was held at the Hotel Stattler, Buffalo, N. Y., May 20-22. President W. F. Jones, general storekeeper of the New York Central & Hudson River, made an address. Special mention was made of the work of the committees, and particularly of the tinware committee, which had been in conference with similar committees of the Master Mechanics' and Master Car Builders' Associations for the purpose of standardizing tinware. It is believed that the action of this committee, if accepted, will result in the adoption of standards that will be of great benefit both to the railways and to the manufacturers. In fact, some roads are waiting for this report before ordering large amounts of tinware.

The membership of the association has been increased, the total number, according to the secretary's report, being 625.

The committee on accounting requested more time in which to prepare its report. In the discussion it developed that there is a wide difference among the railways in the methods of keeping the accounts. For instance, on the Lake Shore & Michigan Southern the accounting is done by a separate department which is outside the jurisdiction of the supply department, while on certain other roads the supply department has charge of the accounting. The former method relieves the supply department of applying the cost of supplies direct to the operating cost sheet. The Chicago, Burlington & Quincy operates on the same principle as the Lake Shore, except that the supply department puts the price of the material on the bill as it is given out.

The subject of railway salvage or reclaiming of scrap material was considered by the committee on recommended practices, of which H. C. Pearce, general storekeeper of the Southern Pacific, is chairman. A separate salvage department was advocated, which should come under the direct control of the supply department. This new department should gather all obsolete and scrap material for its reclaiming or selling. It should be run according to a definite and well-planned system, so as to prevent any unnecessary handling. It was estimated that 10 per cent of the total cost of the material could be saved. Three inspections should be made of the material before it was scrapped; the first by the workmen overhauling the equipment for repairs; the second by sufficiently trained men at the scrap piles, and the third as it is being loaded on to the cars for shipment. It was claimed that considerable money is lost in rails and ties which could oftentimes be reclaimed by shortening the rails and by using the ties for secondary track and fence posts. E. J. McVeigh, Grand Trunk, who is a member of the committee, also read a paper on the subject. He mentioned many ways in which material is lost that [illegible] He said that [illegible] of all the loss [illegible] of poor education and the [illegible] cussedness." As an example of the former he mentioned insufficient storage facilities and the difficulty [illegible] officers see the necessity for them. As to the latter, he referred to the way in which the employees handled their supplies. He closed by saying that the subject of salvage has been left too much in the hands of the different departments, and that the lack of an organized system was responsible for a large part of the waste.

The discussion brought out the value of the classification of scrap material as drawn up by the previous committees of the association. H. E. Rouse, general storekeeper, Chicago Great Western, said that by following this classification his road had received a large increase over previous prices of scrap and that the extra cost of maintaining the system was more than paid for in this way. D. Kavanagh, general storekeeper, Chicago, Rock Island & Pacific, said that the cost of classifying and reclaiming scrap on that road, using this same system, was only nine cents per ton. The shipment of all scrap to a general overhauling point was criticized by some as not being an economical proposition, since the cost of transportation would be liable to exceed the money saved by the reclamation, but it was conceded that where possible it was better to do this than to maintain salvage crews at each shop. The location of the general overhauling point should be governed by the geographical location of the scrap market. On the Chicago, Burlington & Quincy the reclaiming is done at the shops, the mechanical department co-operating with the supply department in picking out the usable material, the rest being sent to the general scrap docks at Havelock, Neb.

The committee on scrap classifications made a few changes that were found necessary on account of the increasing use of steel. However, no change was made in the classification of No. 1 scrap, which at present includes both steel and iron. This combination is severely objected to by many of the scrap purchasers.

D. Kavanagh, chairman of the committee on standardization of grain doors, reported that the committee had conferred with the committee of the General Superintendents' Association on reclamation as well as the standardization of grain doors, and with slight modifications had not found any reason to change the recommendations which were made in the previous report. It is still maintained that doors 20 in. wide by 7 ft. long are the most serviceable, and can be used in any freight car suitable for carrying grain having a standard width of door. It was agreed after conference with the committee of the General Superintendents' Association and with Mr. McNulty, the reclamation re-cooperage agent, that better results can be obtained from grain doors constructed with the two end cleats set out flush to the end of the door, instead of 6 in. back from the end as previously recommended. There is more nailing stock at the end of grain door, making it more substantial and less liable to be damaged in removing it from cars. For railways buying grain doors made of hard woods, it is not believed neces-

sary to have a complete double door, i. e., a door made with a full double thickness of lumber all the way through, single thickness hard wood doors being equally as strong and serviceable as double doors made from soft wood, if all cracks are properly cleated.

Roads that can purchase hard wood doors to advantage, constructed as above described, will save approximately $25,000 to $30,000 a year where large quantities of these doors are required. In order to have the marking of grain doors uniform on all railways, it is recommended that on the inside the door should be properly stenciled with the initials of the railway in large letters, and also the name of the manufacturer of the grain door, this latter information for identification purposes. On the opposite side of the door, that is, the outside, should be stenciled also in plain large letters—"This Side Out—Return to A. B. & C. R. R."

A paper was presented on line inspection by J. H. Callaghan, Canadian Pacific, which was briefly as follows: Line inspection offers a big field for the head of the store department. On some lines there are no less than 50 places where materials are carried, all of which come under the care of the various division storekeepers, and while these form a portion of the line inspection they do not afford anything like the field to work in which is offered by the line proper, or such places as engine houses, car repair yards, bridge and building department shacks, construction yards, steamship, ferry and elevator terminals, freight and baggage sheds, etc., in fact, wherever company material is apt to be found, whether new, second-hand or scrap. These are the places where the general storekeeper with the inspection team can do a lot of valuable work.

The inspection team should consist of the general manager, or an officer of equal rank, the general master mechanic, the master car builder, and the general storekeeper. The general manager because he is in charge of all lines on which such inspections are made and decisions are arrived at on the ground. The general master mechanic because all division master mechanics are subject to his instructions. The master car builder for similar reasons, the various division car foremen being subservient to him; and the general storekeeper because he is the custodian of the materials no matter where located.

A rough outline of the work of inspecting is as follows: The general manager watches the line from the rear end of the car, noticing station buildings, cattle guards, fencing wire, switch material, ties, etc., not properly cared for, and speaks to the general superintendent of the division together with the superintendent in charge of the district as to these conditions and directs as to their proper disposition. The general master mechanic notices 160 to 180 per cent locomotives hauling regular trains where an engine of less capacity would answer the purpose and arranges at once with the division master mechanic for the proper disposition of this misplaced power. While in the engine houses and machine shops he looks into the work of proper upkeep of machines and engine house practice. The master car builder covers very much the same ground.

A paper was presented by H. C. Pearce, Southern Pacific, on how the efficiency of the store department may be increased. He said in part: "Efficiency is simply doing the thing we are required to do well, in the most simple and direct manner. If the railway storekeepers are not as efficient as they should be the fault lies more in the foundation than in the superstructure.

"The store department, which is better named the supply department, is particularly unfortunate in that it has no unit of measure. The measure it has made for itself is stock on hand, issues, and pay roll. This, if carried to its utmost conclusion, presents the spectacle of a storekeeper, whose first duty should be to meet the demands of the service, being without stock; whose second duty should be to husband his resources, endeavoring to increase his issues; whose third duty is to take proper care of the property in his charge, and make the most of the salvage by applying it to the company's needs, and the residue for the market (all of which necessarily means an increased pay roll), making every effort to have this work done by others, if it is done at all, and planning in every way to keep his pay roll down to the lowest possible point, regardless of what saving can be made for the company.

"The supply department is probably the only department that has not so far developed a proper unit of measure. A railway is operated primarily for the purpose of moving trains, and the officers and men directly engaged in this work are measured by their ability to handle the business. In order to analyze the efficiency of the supply department we must first determine its real purposes, which I conceive to be: Service rendered by providing proper materials promptly; proper inspection and protection of all company property; conservation of its resources; cost of handling and accounting.

"If this fairly represents the purpose of the supply department, then we must be measured first by the service given every day in the way of providing suitable materials economically, delivering them to the work when they are wanted, proper protection and control of the property under our charge to prevent deterioration and misuse, the assembling of it at proper locations for proper control so that it can be conserved, the installation of system and order in the arrangement of the stocks and the men engaged in handling, so that the cost of handling may be as low as possible; the picking up and bringing in of the salvage, assembling it for market, making it over for further use, and arranging and classifying the scrap for the market.

"Investment in materials will always be a prominent unit of measure, and rightly so, but it must be coupled with other things and be understood before it can be considered the unit of measure. There is no question but what the stocks of material as represented by the balance sheets of our different roads is too high. I should say as a general proposition that they are double what they should be. Much of this is due to causes over which the storekeeper has no control. Purchases continue to be made of large quantities of materials without the authority of the supply officer. With few exceptions, our railways have not so far seen fit to place all the materials on the road entirely in the hands of the supply officer, in fact, our general storekeepers today are, generally speaking, little more than custodians. Work is started and stopped without regard to material conditions. Everyone knows that labor can be procured in much less time than material, and that labor can be discontinued at a moment's notice, whereas the material has to be contracted for and must be accepted. This feature alone has probably had more to do with the accumulation of large and unnecessary stocks of material than any other one factor.

"If all our railways were to adopt a standard classification of material, segregated sufficiently to clearly expose the principal items, and this classification was supported by a uniform accounting system, the issues would be accurately reflected. This would bring clearly before all officers interested the question of why a certain investment was necessary to protect a certain issue. For this reason the stock on hand and ratio of issues always have been and always will continue to be a unit of measure. Summing the entire matter up, the efficiency will be reflected in the ratio of purchases to the actual issues.

"Efficiency can be developed from our own organizations. Valuable ideas are more apt to come to the men engaged in the work than they are to men who grab them out of the air. The efficiency idea is merely analyzing in detail each thread of the work and applying it in the simplest and most direct manner. By selecting from our own organizations men with the faculty for analyzing and construction, and giving them the support and opportunity to investigate and apply these thoughts, we get all the benefits of the men who are engaged day by day in this particular work, or, in other words, we get practical efficiency instead of theoretical efficiency.

"Several of our large systems have already placed a vice-president in direct charge of their supply departments, and it is only a matter of a short time when this department will be thoroughly reorganized along the lines of greater efficiency and broader usefulness."

Three papers were presented on oil and waste by W. O. Taylor, of the Galena Signal Oil Company; C. H. Tallman, of the New York Central & Hudson River, and E. C. Totten, of the same road. Mr. Taylor considered chiefly the illuminating and lubricating oils, giving valuable information as to the properties of these oils and the manner in which they should be stored. He spoke of absorbent towels which are used as a substitute for waste for general wiping purposes. By means of an "emulsion machine" oil can be extracted from these towels which can be used in the signal department for lubrication of switches.

From a report of a road using these towels it was learned that in one month 6,695 towels were washed at a cost of $26.50 and returned to the shops; there was a saving of 4,000 pounds of colored waste. On this basis 24,000 pounds would be saved in six months at a cost of $1,440. Subtracting from this the cost of 6,695 towels ($311.28) would give a saving of $1,138.72.

Mr. Tallman spoke of the care of hard grease in the storeroom and the saving that can be made by reclaiming old grease. He described a process by which it can be made over into serviceable stock.

The rest of the session was given over to the answering of queries sent in by members and by the closing exercises. In the answer to the question as to whether the saving would justify a $50 or $60 man for classifying a scrap pile of about 70 tons a month, it was brought out that if the man was limited to that work alone it would not be justified, but he would undoubtedly have time and opportunity for other work. A good man at the scrap pile is absolutely necessary for the moral effect it will have on the shops sending in scrap. If the shops receive back useable material, which they send in as scrap, they will be more careful in reclaiming material. On some roads the higher officers require reports showing the amount of useable scrap returned to the different departments.

G. G. Allen, Chicago, Milwaukee & St. Paul, stated in connection with the subject of surplus material that the general storekeeper should be constantly in touch with what is going on on the road, so as to plan for any new material that may be required and also to pick up material not needed.

The memorial committee passed resolutions on the deaths of J. R. Lawler, Grand Trunk, and A. I. Miller, Missouri, Kansas & Texas.

New officers were elected as follows: J. R. Mulroy, St. Louis & San Francisco, president; J. W. Gerber, Southern Railway, first vice-president; G. G. Allen, Chicago, Milwaukee & St. Paul, second vice-president; J. P. Murphy, Lake Shore & Michigan Southern, secretary and treasurer.

WESTERN RAILWAY CLUB.

The Western Railway Club held its last meeting of the season on Tuesday, May 21. After the election of officers, trustees and directors, a vaudeville performance was given by certain talented members of the club. The following officers were elected: President, T. H. Goodnow; first vice-president, Henry La Rue; second vice-president, W. B. Hall; secretary and treasurer, J. W. Taylor. The newly elected officers of the executive committee are C. J. Olmstead, St. Paul, and E. W. Pratt. Those who took part in the program are as follows: Arthur Scott, J. Will Johnson, Fred S. Hickey, Frank Ryan, W. L. Riedell, Gus Voss, C. B. Roe, Jack Ponic, Oxford Quartet.

Test of Jacobs-Shupert Firebox

Concerning the comparative tests of locomotive boilers equipped with the Jacobs-Shupert and ordinary fireboxes now being conducted by W. F. M. Goss at Coatesville, Pa., the following is a report of progress. The program for the tests was given in an earlier issue of the *Railway Master Mechanic*. In the photographic reproduction herewith, the boilers are shown prepared for the tests. The boiler with the standard firebox is at the left. The Jacobs-Shupert firebox is on the boiler at the right.

The Boilers.—Two boilers have been employed in the tests, one having a firebox of the radial-stay type, hereinafter referred to as the radial-stay boiler, and the other having a firebox of the Jacobs-Shupert type, hereinafter referred to as the Jacobs-Shupert boiler. Both boilers are identical in their general dimensions which are as follows:

Outside diameter of shell of boiler at front end	70	ins.
Diameter of shell at throat	83⅞	ins.
Number of 2¼-in tubes	290	ins.
Length of tubes	218	ins.
Inside length of firebox	109⅜	ins.
Inside width of firebox	76⅜	ins.

The purpose of the tests of Series A was to determine for each boiler the evaporation from the firebox and from the tubes separately. To make such a determination possible, the back tube-sheet was extended in all directions to the outside of the boiler, thus forming a diaphragm completely separating the water-space on the two sides of this tube-sheet. By this device each boiler was made in effect two boilers, the heating surface of one being all portions of the firebox, excepting the front tube-sheet, and the heating surface of the other being the tubes and tube-sheets.

In carrying out the tests, each compartment was supplied with weighed water as though it were a separate boiler. The quality of the steam delivered from the firebox end and from the barrel end was determined independently, the purpose being to determine with the highest possible accuracy the heat delivered through the walls of the firebox and the heat delivered through the flues. The general dimensions of interest in this connection are as follows:

Heating surface, square feet:

	Radial-Stay Boiler	Jacobs-Shupert Boiler
In the firebox	179.2	201.9
In the barrel	2805.1	2806.5
Total for both parts of the boiler	2984.3	3008.4

Tests With Oil.—A series of oil-fired tests have been run on each boiler. Three different rates of power have been employed in each series, the rate of fuel consumption ranging from 800 pounds of oil per hour to 2,100 pounds of oil per hour. The total water evaporated from both the firebox end and the tube end of the boilers has ranged from 10,000 pounds per hour to 24,000 pounds per hour, the evaporation per pound of oil being approximately 16 pounds in the tests of lowest power and approximately 14 pounds in those of highest power. In all these tests a surprisingly large percentage of the total work is done by the firebox. This percentage is greatest when the rate of power is lowest. Speaking in general terms, at low rates of power from 45 to 50 per cent of the total heat transmitted by the boiler is absorbed by the firebox. With increase of power the percentage falls, but the lowest value thus far obtained is approximately 34 per cent.

As the heating surface of the firebox is a comparatively small fraction of the total heating surface of the boiler, it is evident that heat is transmitted from the firebox at rates which are extremely high. For example, results of a number of tests show the evaporation of more than 50 pounds of water per foot of firebox heating-surface per hour, which

Boilers Arranged for Test, Jacobs-Shupert Fire Box at Right.

rate of evaporation is equivalent to the development of more than 300 horse-power by the firebox alone. In estimating the significance of these results, it should be remembered that in the experiments, the firebox virtually constitutes a boiler by itself, that it had no more water about it than the normal locomotive firebox, and that it could not benefit by the circulation of water from the forward end of the boiler backward into the water legs. The fact that fireboxes subjected to such conditions could be worked at the rate of power stated, is suggestive of new possibilities in boiler design. The full development of these data will make of record facts with reference to the distribution of work between the firebox and tubes of a modern locomotive boiler which have never before been determined.

The experimental results have not yet been sufficiently studied to permit a final statement to be made concerning the relative performance of the radial-stay boiler and the Jacobs-Shupert boiler. It appears, however, that the absorption of heat by the Jacobs-Shupert firebox is somewhat in excess of that absorbed by the radial-stay firebox, and that taking the boilers as a whole, the Jacobs-Shupert boiler is slightly more efficient.

Tests with Coal.

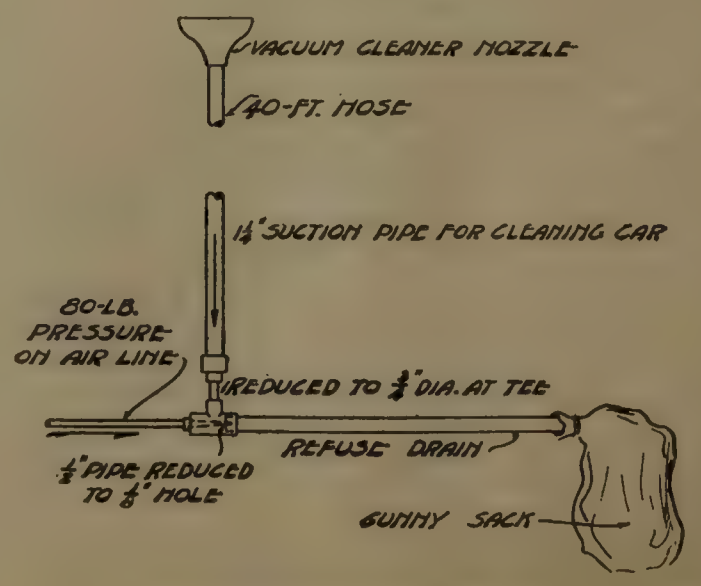
The oil-fired tests already described have been duplicated by a series of coal-fired tests. The results obtained, so far as they refer to the distribution of work between the firebox and the tubes and to the relative performance of the radial stay boiler and the Jacobs-Shupert boiler, are in entire agreement with those obtained from oil.

General.

This series of tests will culminate on June 20, at which time both boilers will be subjected to low water conditions Both will be similarly treated until failure occurs.

HOME-MADE VACUUM CLEANING OUTFIT.

A home-made vacuum cleaning outfit has been devised in the shops of the Ohio Electric Railway at Lima, Ohio, which is used with very satisfactory results in cleaning the cushions and backs of car seats. This arrangement is shown in the accompanying drawing. It was worked out as an adaptation of the principle upon which a steam siphon works. The shops of the company at this point are equipped with a compressed air system, with National 3 C pump, the air being used for numerous shop purposes and for blowing out motors, controllers, etc. Each pit is equipped with an air line carrying 80 lbs. pressure. A ½-inch pipe from this air line is narrowed down to a nipple with a ⅛-inch hole in the end which is thrust into one end of a 1¼-inch tee, the other end of the tee being connected with a refuse drain pipe leading to an ordinary gunny sack. Into the side of the tee is a ¾-inch pipe connected to a 1¼-inch suction pipe consisting of 40 feet of hose and terminating in a vacuum-cleaner nozzle. The force of the air through the ⅛-inch nipple creates a sufficient vacuum in the suction pipe to thoroughly clean all surfaces to which the vacuum-cleaner nozzle is applied. It is found that a man can get over a 55-foot car and do a good job of cleaning in 20 minutes. In addition to the cleaning of seats which is done with this vacuum outfit in connection with the sweeping out of the car, especially in dusty weather, the seat cushions and backs are taken out whenever the cars go into the paint shop and all corners are thoroughly blown out with air taken directly from the pipe line. The woodwork of the car is then thoroughly wiped and the car cleaned inside and out.—Electric Traction Weekly.


VACUUM CLEANER NOZZLE
40-FT. HOSE
1¼" SUCTION PIPE FOR CLEANING CAR
80-LB. PRESSURE ON AIR LINE
REDUCED TO ¼" DIA. AT TEE
REFUSE DRAIN
¼" PIPE REDUCED TO ⅛" HOLE
GUNNY SACK

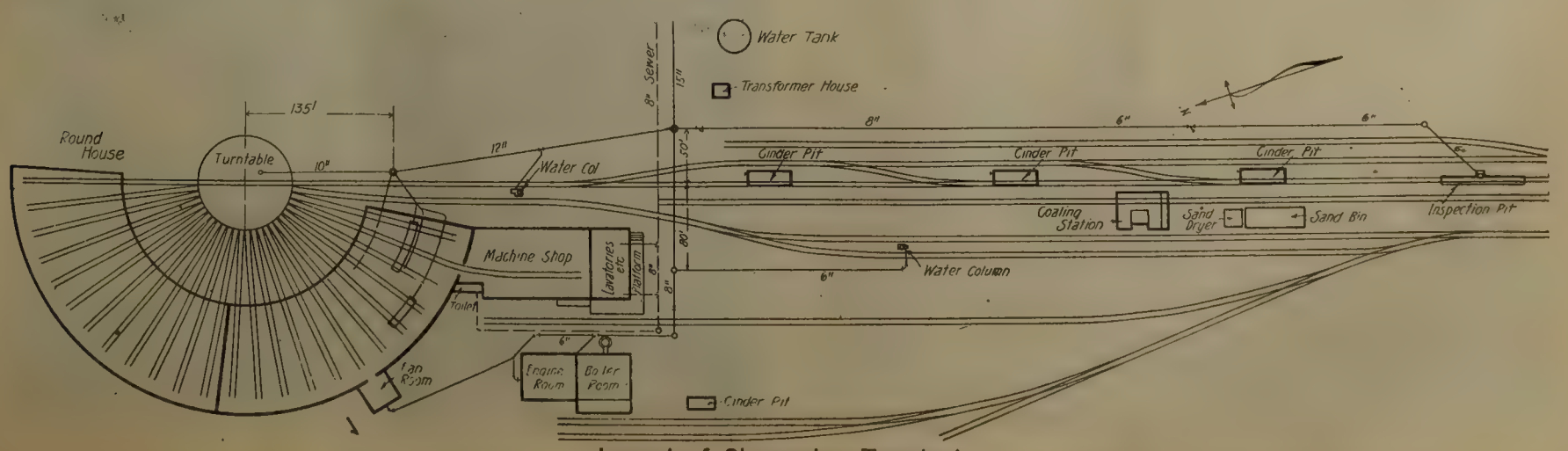
Home-Made Vacuum Cleaner.

Champaign Terminal.

The Illinois Central has just completed a terminal at Champaign, Ill., which together with the classification yards being completed at Centralia, will greatly facilitate the movement of freight bound for Chicago. Centralia is 251 miles south of Chicago on the main line to the Gulf and here freight bound for Chicago or for points west is classified and made up. Champaign is 126 miles south, on the main line and is a mid-way division point between Chicago and Centralia. The old terminal at Champaign was in the city, near the business section and therefore located on valuable ground and its future development was limited. So it was decided to build a new terminal, and for this purpose a tract of land two and a half miles north of the city was purchased at a reasonable price, which it has been estimated will amply provide for all needs for at least twenty-five years to come. The project just completed represents only about one-sixth of the development which is possible at this point.

The new Champaign terminal includes a 24-stall roundhouse, machine shop, store room, power house, coaling station and cinder pits. The radii of the inner and outer circles of the roundhouse are respectively 111 ft., 5¾ in. and 212 ft. The footing walls are of a 1-3-6 concrete mixture and are designed for a pressure on the soil of 4,000 pounds per square foot. All timbers used in pit construction are creosoted and at present a cinder floor is being used in the roundhouse, the plan being to put in a brick floor in about a year when the foundations will have settled. As may be seen in the layout drawing, there are three driver pits and two truck pits, both truck and driver pits being served by 3,000-pound capacity jib cranes equipped with chain hoists. Posts are 10 in. x 10 in. and 12 in. x 12 in., with 10 in. x 16 in. girders, and the roof is 5-ply tar and felt laid on 1¾-in. plank. The 24-stall house is divided into two sections by a 13-in. fire wall having a fire door at each end. Adjacent to the outer circle and opposite stall eight is a fan house 29 ft. x 27 ft. containing the fan which draws the air over heating coils and forces it into the heating duct which runs around near the outside circle, with openings into each of the roundhouse pits. Paul Dickinson cast iron smoke jacks

General View of Champaign Terminal.



Layout of Champaign Terminal.

Interior of Champaign Roundhouse.

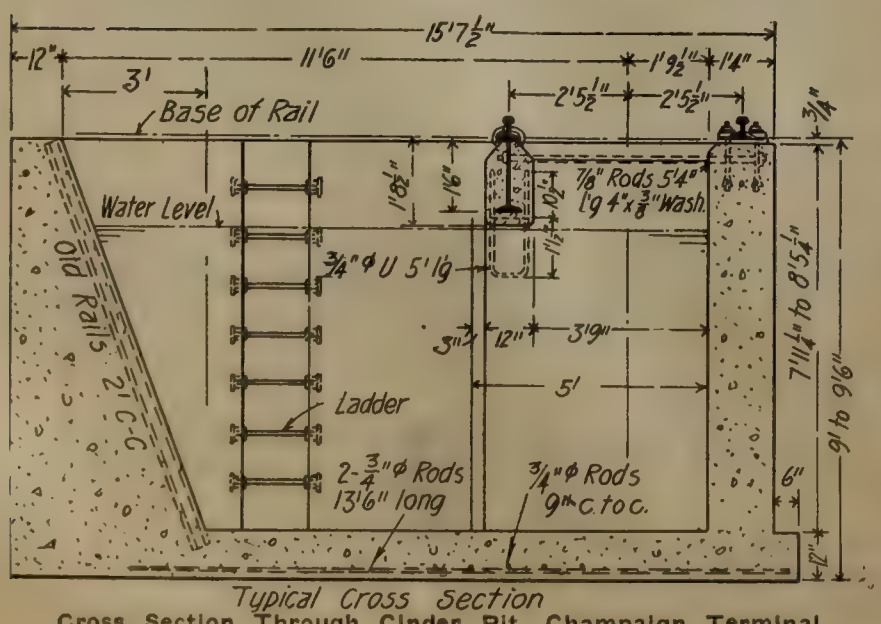
are used, and the boiler washing system was installed by the F. W. Miller Heating Co., of Chicago.

At one end of the roundhouse and joining it, is the machine shop, about 65 ft. x 110 ft., containing also the offices of the foreman and the boiler inspector, together with a tool room, toilet room and engineers' register room. It will be noted in the layout that one track from the roundhouse runs into the machine shop. The shop is well equipped for light repairs, the following being the list of machine tools installed:

Acme Bolt Cutter,
Barnes 42-in. vertical drill,
Schumacher & Boye 22-in. engine lathe,
Ryerson sensitive drill,
Niles-Bement-Pond 36-in. engine lathe,
Cincinnati 20-in. shaper,
Safety double emery grinder,
30 in. x 30 in. x 10 ft. Niles-Bement-Pond planer.

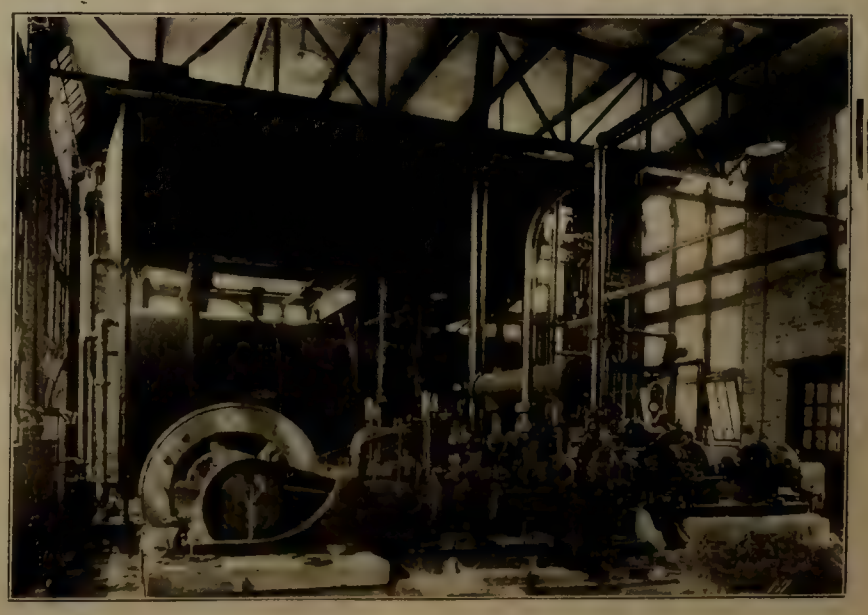
The storeroom is a two-story addition at one end of the machine shop, and is 36 ft. x 65 ft. At one end of the lower story of the addition, are the offices of the road foreman of engines, general foreman and clerks; at the other end are located seven oil pumps which were installed by the Fort Wayne Oil Pump & Tank Co., of Fort Wayne, Ind., while in the center is the storeroom proper. Outside, a cinder and cement platform surrounds the building on two sides. In the upper story is a locker room containing 218 12 in. x 12 in. x 36 in. double tiered lockers with expanded metal doors. Here also is a toilet room with showers and a commodious engineers' lounging room. These latter facilities are instances of the way in which a modern railroad treats its employees.

Nearby is the power house, a brick building with steel roof trusses, the roof being composed of concrete slabs which are

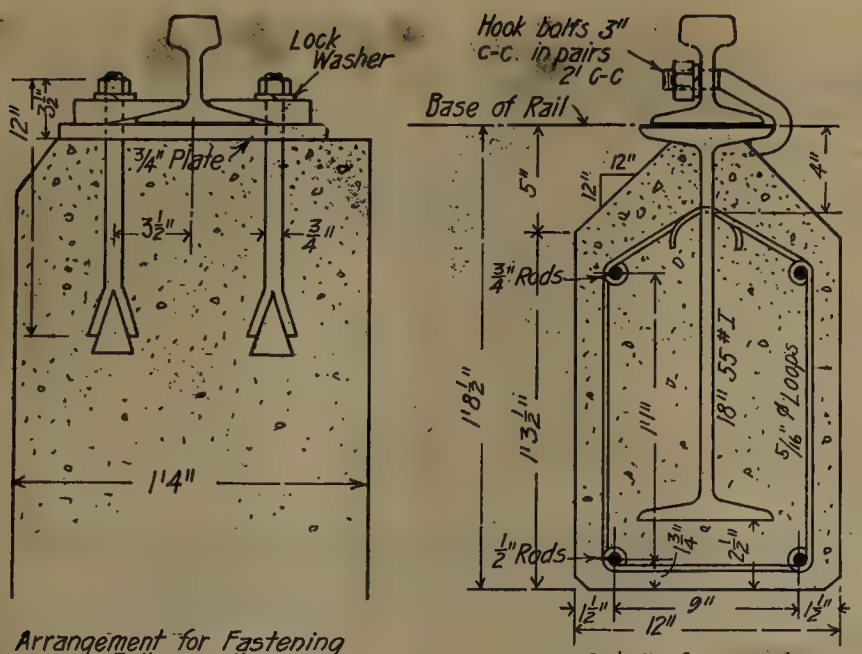


Typical Cross Section

Cross Section Through Cinder Pit, Champaign Terminal.



Miller Washout System in Power House (Note Concrete Roof).

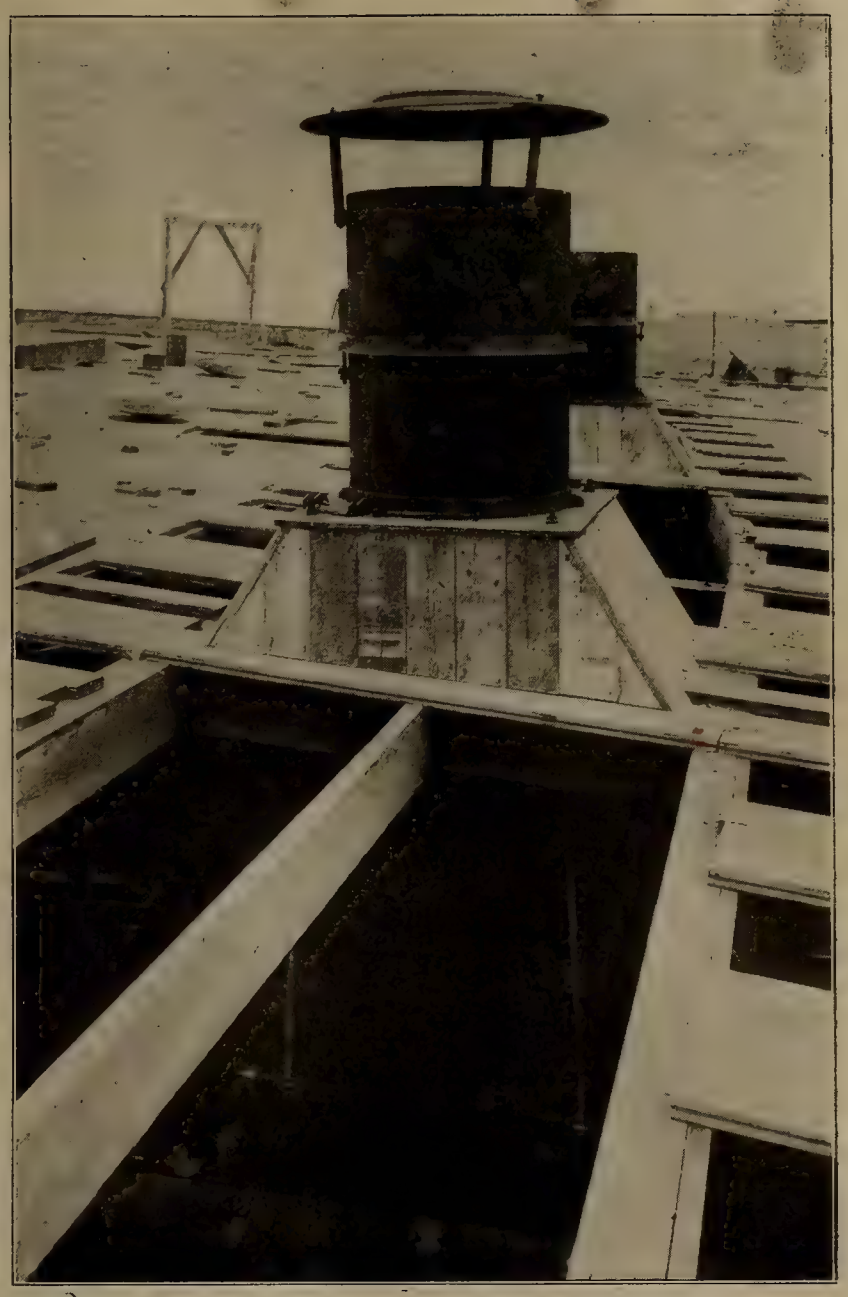


Arrangement for Fastening Rail on Wall. Split Bolts 2'6" C. to C. 1' long

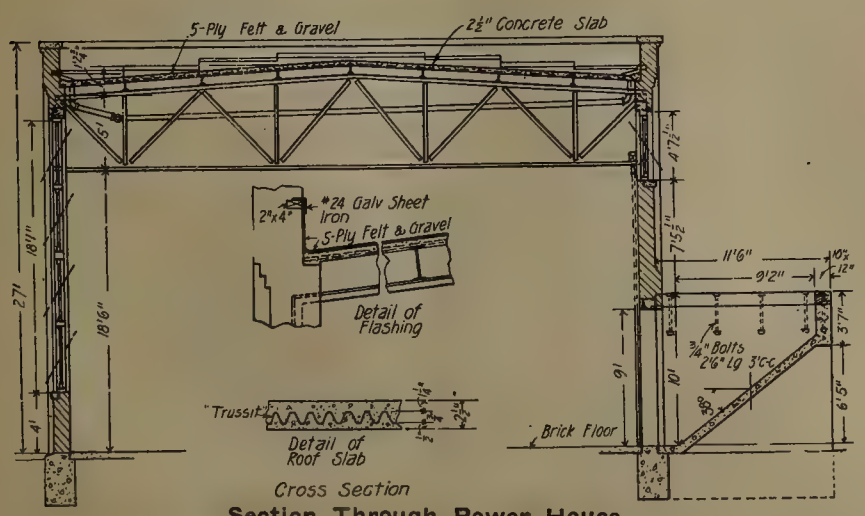
Detail of Concrete Covering for Beams.

Rail Fastenings at Cinder Pit.

Snow Coaling Station.



Dickinson Smoke Jacks.

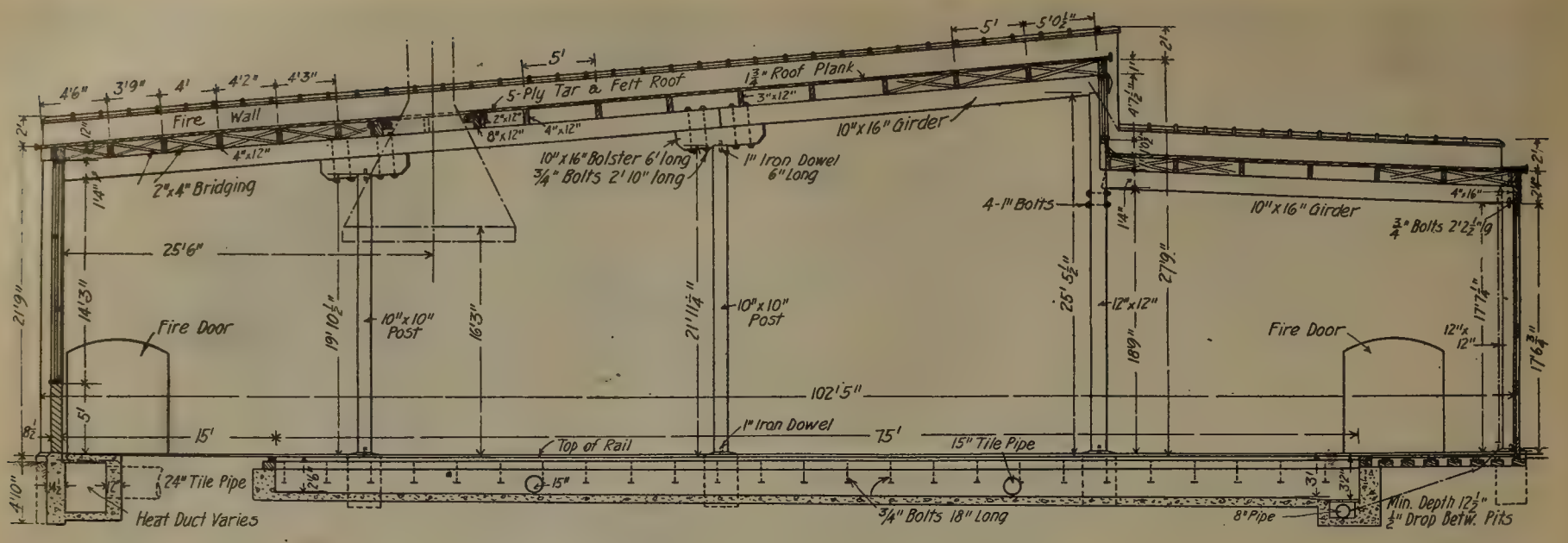


Cross Section

Section Through Power House.

quite thin, their average thickness being about 2½ in., and are covered with 5-ply felt and gravel roofing. Concrete is used as a flooring. The coal bunkers are of concrete, built through the wall at one side, discharging directly in the power house and have a capacity of 175 tons. The chimney which is of reinforced concrete, was built by the Weber Chimney Co., is 153 ft. in height, with a diameter of 5 ft. at the top and 10 ft. at the bottom and rests on a 20-ft. concrete base. The power house is equipped with three 72 in. x 18 in. Chandler & Taylor horizontal tubular boilers having a total horsepower of 450. They are equipped with Burke stokers and Blake-Knowles open type feed water heater. There is also a 1,000 gallons per minute Allis-Chalmers centrifugal fire pump and a 1,000 cu. ft. Laidlaw-

Showing Ample Provision for Light, Champaign Roundhouse.



Section Through Roundhouse, Champaign Terminal.

Dunn-Gordon air compressor. A distributing switch board is located in the building and the primary transformer is located in a separate house outside. The Miller washout system is also located in the power house.

The coaling station is of wooden construction, on a concrete base, and has a capacity of 600 tons. It was installed by the T. W. Snow Construction Co., of Chicago. The cinder pits are of concrete composed of one part Portland cement, 2½ parts sand and 5 parts stone. To protect the sides, old rails are placed on the slope, laid on two-foot centers. Cinders are handled by a locomotive crane, and clam shell bucket. In addition to the above, there is an inspection pit and a sand drier.

The water tank is of standard wooden construction having a capacity of 100,000 gallons. The water supply is furnished by eight 10-in. wells having a depth of from 165 to 172 ft. Power house and the roundhouse pits are connected to a 15-in. drainage sewer laid on a 1¼ per cent grade, leading to the drainage ditch. Manholes are placed at convenient intervals. The sanitary sewers are a separate system having 8-in. and 6-in. pipe and leading to the septic tank which is 8 ft. x 20 ft. x 8 ft. The yard is lighted by 16 arc lights and in accordance with up-to-date practice tungsten lights are used in power house, roundhouse and machine shop. In the roundhouse 250-watt tungstens are used, three being placed between pits; in the power house 150 watt tungstens are used and the machine shop is supplied with Benjamin clusters holding five 40-watt tungstens. The construction work on this project was done by Westinghouse-Church-Kerr & Co., under the supervision of the Engineering Department of the Illinois Central R. R. to whom we are indebted for the above information.

FUEL AS A FACTOR IN LOCOMOTIVE CAPACITY.*

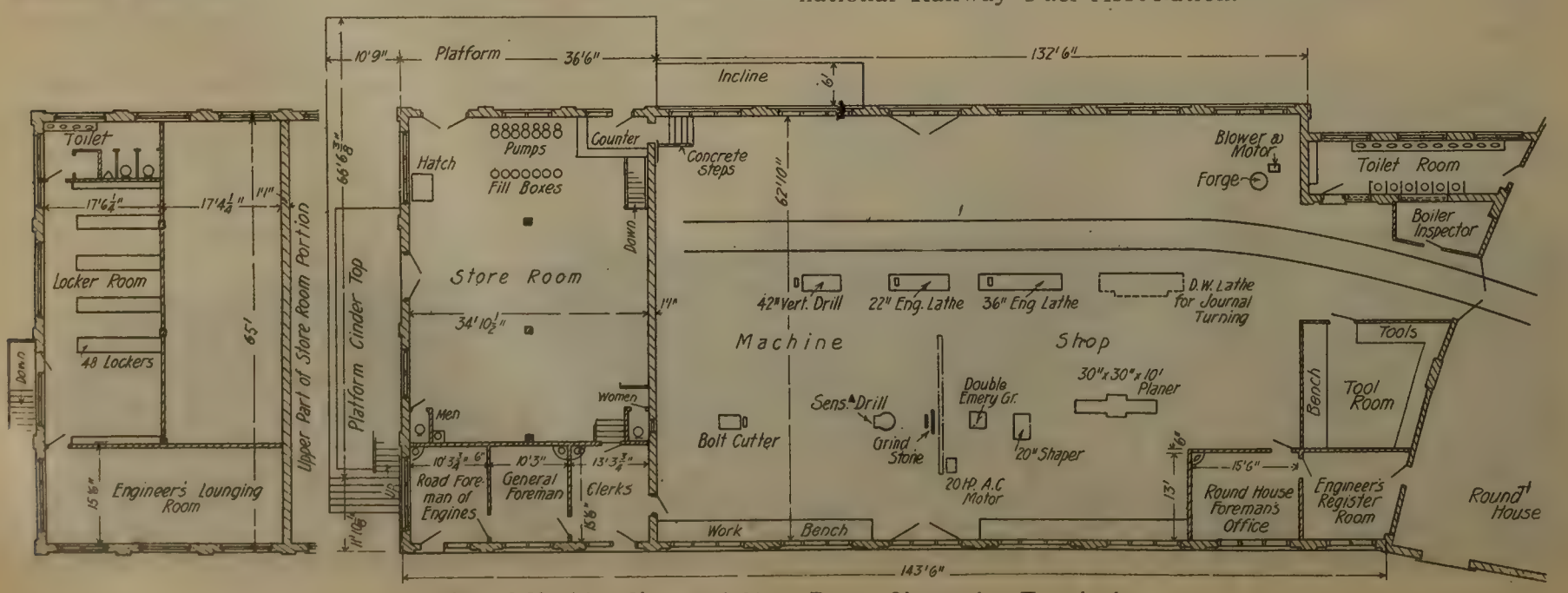
By W. F. M. Goss.

The power developed by a steam locomotive is derived from the fuel it consumes. Other things being equal, the greater its rate of fuel consumption the greater will be its capacity. Success in the development of this problem long ago characterized the locomotive as the hardest worked of all types of steam plants. This characterization is based upon the fact that the draft which urges the locomotive fire is unusually strong, its value as measured by a draft gauge under normal operating conditions ranging from 5 to 12 inches of water; that this strong draft results in the burning of from 100 to 200 pounds of coal for each foot of grate per hour, and a rate of evaporation which may exceed 16 pounds of water per foot of heating surface per hour.

The draft, the rate of combustion, and the rate of evaporation are matters which have been subject to little change during the last quarter of a century, but the demand for increase of power has been present throughout this period. The demand has been met by increasing the dimensions of the locomotive. Boilers and cylinders have gradually been made larger, and all the details of mechanism have been designed to control and transmit the increases in power for motive; a machine of unprecedented power, a complete steam-power plant which, as represented by a recent design, is capable of developing a horsepower for each 121.4 pounds weight.

But the weight of the modern locomotive cannot be greatly exceeded except at the expense of extensive improvements

*A paper delivered at the annual convention of the International Railway Fuel Association.



Plan of Machine Shop and Store Room, Champaign Terminal.

in track or through the adoption of an arrangement of wheels which will permit the load to be much more widely distributed than at present. As it is not likely that the demand for higher power will cease, the problem of supplying it is one of more than academic significance. It presents two possible lines of solution, both of which are of especial interest to the members of this Association. One possible line of development is through the better adaptation of fuel to the needs of locomotive service, and the other is through the better adaptation of the locomotive to the requirements of the fuel which it has to burn. It is my purpose to discuss briefly the possibilities of increasing locomotive power by attention given to each of these lines of development.

It is obvious that anything which will successfully promote the combustion of fuel in the firebox of a locomotive will at the limit operate to increase its power. Every pound of coal effectively burned represents a definite output in the form of power at the drawbar, and if through care in the choice and preparation of the fuel the rate of combustion can be materially increased, it is evident that the maximum capacity of a locomotive may be advanced. This fact is lost sight of when locomotives performing service, in which maintenance of schedule is a matter of great importance, are supplied with coal bad in its composition and which is a mixture of the finest dust with lumps of every possible size. Conditions of service which demand high power will justify unusual care in the selection of fuels. The coal used under such condition should have a high thermal value, and it should be low in clinker and ash. It should be sized before it is put upon the locomotive tender and if necessary it should be washed and sized. One who looks upon sized coal in a car and then upon a carload of run-of-mine coal and considers that on the grate the combustion of coal can only proceed as air can pass through the bed and around the individual particles of coal, will easily understand the superior advantages offered by the sized fuel. A principal advantage of the briquetted fuel so much used in foreign railroad practice is to be found in the fact that the briquettes are of uniform size. When the coal fired is made up of pieces of uniform size, it forms a bed on the grate in which the interstices between the pieces of coal are uniform and the admission of air over the entire area of the grate is in finely divided and uniformly distributed streams. The result is that every part of the fire is maintained in a condition of maximum efficiency; the temperature of the firebox will be higher than when mixtures of lumps and fine coal are fired; the rate of combustion will be greater, and, as a consequence, the capacity of the locomotive will be increased.

It is obvious that the power of a locomotive cannot be increased indefinitely merely through the proper selection of fuel, but the limits of its maximum performance may be materially extended. Through care in the selection of fuel, a small locomotive may be made to perform the service of a larger one, a saturated steam locomotive may be made to perform the service of a superheating locomotive of the same class, and a large locomotive may have its power limit materially increased.

There are no objections to the general introduction of especially prepared fuel for locomotives excepting those of cost. The fuel bill of the railroads is already an enormous one, and those who are responsible will always hesitate before permitting an increase in the purchase price per ton. But the ultimate cost, when measured in terms of service given, will be found in many cases justifiable. Under present practice, railroads in their desire for some increase in power, do not hesitate to increase the weight of their locomotives by giving them larger boilers, by raising their steam pressure, by the adoption of compound cylinders, and by the addition of superheaters. All of these are expensive measures, but they have been justified in practice by the results obtained. The more careful preparation of fuel is to be looked upon as a means to an end. It constitutes an embellishment in locomotive operation and is not different in purpose from embellishments in design. It will add to the expense, but will give a return in increased power which at the head of important trains may be greatly needed for the maintenance of service. I believe that a great opportunity, which as yet has been but little appreciated, lies awaiting the attention of the prophet who will proclaim the gospel of increased power of locomotives through the more careful selection of their fuels. The time is at hand when lump coal will be washed and sized, and when the fine coals will be washed and briquetted. These processes, excepting that of briquetting, are inexpensive processes and a demand for their employment will soon be forthcoming from the railroads.

The alternative plan whereby the power of the locomotive may be increased, is that which provides for a development of its design along lines which will give it greater capacity to consume the indifferent fuels which under present practice are commonly supplied it. What changes need be made in present practice to provide a greater fuel-burning capacity? The first requisite in the development of such a design is a large grate. The fact is recognized that grate areas have increased enormously during the last 25 years, that whereas their area used to be less than 20 square feet, they now have an area which is often more than 70 square feet. If a design could now be made which would permit the present maximum grate area to be doubled, several important results would at once be secured. First, while the total amount of fuel burned per unit of time might be materially increased, the rates of combustion per unit area need not be increased, it could even be reduced. The increase of power would be proportional to the increase in the total fuel burned, while the reduced rate of combustion would avoid the necessity for special care in the selection of fuel; would allow the use of fuels now normal to locomotive service; would operate greatly to reduce the loss of fuel in the form of sparks, and would prolong the period during which the locomotive could be kept in continuous operation. For example, when 6,000 pounds of coal are burned per hour on a 60-foot grate, the rate of combustion is 100 pounds per foot of grate per hour and the spark loss with many fuels represents fuel values which approach 10 per cent of the coal fired. The collection of ash and clinker on the grate so much impedes the draft as to require a thorough cleaning of the fire after a run in passenger service of from 100 to 150 miles. A greater distance, if attempted, must generally be run at reduced power. With a large grate these conditions are all changed. The burning of 6,000 pounds of coal on a 120-foot grate would reduce the rate of combustion to 50 pounds per foot of grate per hour, and the spark loss to 2 or 3 per cent, and would permit continuous operation for a passenger run of 300 miles between the cleaning of fires. It is true that the larger grate would be at some disadvantage with reference to losses in the form of fuel left on the grate at the end of the run, and in the larger amount required to cover the grate in the process of starting fires; but these would be entirely neutralized by the possibility of increased mileage between the starting of new fires. With the larger grate, only half as many new fires would need to be made per thousand miles run as were formerly required. While the same total amount of coal is burned in each case, it is evident that the 8 per cent saving in spark losses would at once be made available as an 8 per cent increase of power; also that among the possible variations in the method of taking advantage of the presence of the larger grate will be includ-

ed the possibility of increasing the rate of combustion. For example, an increase in the total fuel consumed from 6,000 to 8,000 pounds an hour, would increase the power capacity of the locomotive by 33 per cent and would involve rates of combustion which judged by the present-day standards in locomotive service would be accounted low. If the rate of combustion were forced to a total of 10,000 pounds, the increase of power would be 66 per cent and the rate per unit area of grate would still be below the maximum now common in locomotive service. There is, therefore, much to be accomplished by increasing the grate area of a locomotive. If the output of power remains unchanged, it will permit lower rates of combustion, a reduction of spark loss, and the use of inferior grades of fuel. If, on the other hand, the rate of combustion per unit area of grate remains unchanged, the output of power may be increased in proportion to the increase in the area of the grate.

Locomotive grates having an area of 150 feet or more would necessarily involve some new departures in locomotive design. As the width of such a grate could not greatly exceed 7 feet, its length would need to be from 20 to 25 feet. This may mean a complete abandonment of the existing type of locomotive boiler and the substitution therefor of some new type, but it does not necessarily imply such a change. It does mean, however, the adoption of an articulate form of locomotve which will admit of a space of 25 feet or more between the two systems of wheels. It should be possible either to increase the spacing of the frames over this space or to drop the frames so low that the firebox and boiler with attachments may have an unobstructed area the full width of the track clearance for all heights 3 or 4 feet above the rail of the track.

In working out details, automatic stokjng must be provided for. This can best be done by having the stokers feed transversely across the boiler from both sides of the firebox. The stokers themselves may be either of the chain, belt or of the Roney type, or they may consist of any simple feeding mechanism, delivering to fixed inclined grates. They would be very short in the direction of the fuel movement, probably not more than 30 or 32 inches in length, and they would discharge on a flat dump grate running the whole length from front to rear of the firebox. The aggregate width of the individual stokers on each side would, of course, be from 20 to 25 feet, but they would be split up into as many different units as would best provide for the construction of short arches over them. By such an arrangement, the green coal would pass under the mud-ring of the boiler and under a short arch, where it would ignite. It would gradually be pushed forward toward the center of the firebox to the flat dump grate, where it would be met by fuel coming in from the other side. The inward movement of coal from both sides toward the center of the grate would, of course, proceed throughout the full length of the firebox, that is, for a distance which might be as great as 25 feet. The fact that the ignition of the fuel would be under an arch would make the combustion nearly or quite smokeless, a mild draft would make the cinder losses small, while the low rate of combustion per unit area of grate, and the provisions for cleaning supplied by the stokers and dump grate, would permit continuous operation at full power for a very long period.

Narrow hoppers supplying these stokers would open up along the whole length of the firebox on both sides to the full width allowed by the track clearances. The operating mechanism of the stokers, which would be beneath them, would be allowed the same total width. An extension of these hoppers upward on both sides to the level of the top of the boiler or higher, would provide space for all the coal necessary for a run. No coal would be carried on the locomotive tender and none would need to be rehandled on the locomotive. It would all be loaded at once into an extension of the stoker hopper, and its weight would be added to the wheels of the locomotive.

In the discussions of the preceding paragraph, I have assumed that the general type of boiler employed would not be materially different from that now in service. Difficulties would, of course, appear in the construction and maintenance of a stay-bolt firebox 25 feet in length, and whatever the outside form of the boiler might be, some special provision would need to be made in the working out of its construction. A demand for a firebox of such dimensions would doubtless call out various means for supplying it. There would probably be no difficulty in constructing a Jacobs-Shupert firebox of any desired length. The boiler would be so located on the frames of the locomotive that its back-end would be just in advance of the first of the rear system of driving wheels, and a foot-plate carrying all of the auxiliary machinery of the locomotive would extend rearward over the axles of these rear wheels and perhaps over the wheels themselves. A fire-door as usually placed would supply the fireman an opportunity to inspect his fire, and guided by such inspection he would be able to so control the operation of the several stokers as to maintain uniform conditions throughout the length and breath of the grate. The barrel end of the boiler would extend out over the forward system of wheels. So much for the arrangements involving a normal boiler. If it should be desired, an attempt could be made to work out the details of the design, using an entirely new form of boiler, such, for example, as a boiler of the water-tube type; but it is not likely that the adoption of any such new type would of itself simplify the general problem as herein outlined.

In conclusion, permit me to say that I appreciate thoroughly the danger of attempting within the limits of a few paragraphs to outline successfully a locomotive design that is entirely new. I appreciate also the many difficulties to be met in applying any such conception. I can not even claim that I have yet given the matter such attention as will permit me to say that all difficulties are surmountable, but I am convinced that the general scheme is sufficiently promising to justify any study which is likely to be bestowed upon it. My purpose in presenting it is to place before the members of this Association in as forceful a way as possible, the importance of larger grate areas in locomotive practice. If the capacity of locomotives is to increase in the future as it has in the recent past, and if locomotives are to be supplied with such grades of coal as are now commonly used in locomotive service, such a change will be found imperative.

ELECTRIFICATION OF BERLIN STADTBAHN.

The electrification of the Berlin Stadtbahn is projected by the Railway Ministry of Germany. This system is a suburban line around the city of Berlin as shown on the accompanying map from the *Electric Railway Journal.*

In 1895 75,000,000 passengers were carried over the inner circle, while in 1909 the number had increased to 157,000,000. In like manner the suburban traffic rose from 41,000,000 passengers in 1895 to 137,000,000 in 1909. The average number of passengers carried daily in 1909 on the suburban section was 341,300 on weekdays and 784,000 on Sundays and holidays.

Some idea of the probable increase in carrying capacity which will be required in the future may be gained from the fact that the population of Berlin itself, served by the inner circle lines, has increased from 2,017,000 inhabitants in 1895 to 2,898,000 in 1909, while the population of the suburbs has risen from 382,000 in 1895 to 807,000 in 1909.

The carrying capacity of the Stadtbahn is already insufficient for the requirements. Of three suggested remedies for the deficiency, namely, doubling the existing track and

Map of Berlin Stadtbahn.

station facilities, building new underground railways and installing an entirely new system of urban and suburban railways, all have been proved to be impracticable on account of engineering and financial difficulties. Under present steam conditions, it is not possible to operate more than twenty-four trains an hour in each direction, each train having a seating capacity of 488 passengers. The minimum service which will meet the requirements of 1916 would be rendered by thirty trains an hour, each seating 610 passengers, but it is necessary to provide for further increases and to allow for at least forty trains an hour in each direction. As it is impracticable to increase the length of the trains and to use two steam locomotives for each, the only possible solution is electrification.

After electrification had been decided upon, there still remained the choice between locomotives and multiple-unit motor cars. Electric locomotives, according to the report, have many advantages. Two or more can be connected to each train and operated by one man, by a simplified multiple-unit system; they are less destructive to the permanent way than either steam locomotives or electric motor cars, and one of them can take the place of many motor coaches. The cost of maintenance of electric locomotives is proportionately smaller than that of motor cars and the electrical equipment is well protected and easily accessible. The amount of electrical energy consumed will, under similar conditions, be less with them than with motor cars, as the efficiency of the large locomotive motors is higher than that of the more numerous and smaller motors necessary with motor cars. The total weight of the locomotive motor is spring-borne so that there is no noise or vibration from any motors on the passenger cars to inconvenience the passengers. A further important consideration, according to the report, is that by the employment of electric locomotives the very large amount of existing rolling stock can be retained.

The electric trains at the hours of heaviest traffic will consist of thirteen six-wheel coaches, propelled by two electric locomotives, one in front and one at the rear. During slack periods groups of five cars or eight cars will be hauled by one locomotive. By fitting the end passenger coach with a controller it will be possible to control and drive the shorter trains from either end. The maximum length train, consisting of thirteen cars and two locomotives, will weigh 355.5 metric tons.

PETROL INSPECTION CAR, NORTH EASTERN RY.

By Thomas Reece.

An interesting development in the way of driving railway inspection cars has been originated by Vincent L. Raven, chief mechanical engineer of the North Eastern Railway of England. This car was constructed at the Gateshead locomotive works of this railway and is intended for the use of officers on inspection duty. It is fitted with a six-cylinder "White and Poppe" engine which drives through a "Hele-Shaw" clutch to a gear box giving three speeds and a direct drive on the top speed. The gear box was made to Mr. Raven's designs. The drive is transmitted from the gear box through propellor shafts and universal joints to bevel gear on the back axle.

There are two large bevel wheels on the back axle, either of which can be put into mesh with the driving pinion, and this allows for the vehicle being driven in either direction. Cooling radiators are fitted on the top of the saloon at each end, and the cooling water passes through each in series. The saloon is arranged so that it can be driven from either end and the brakes can also be applied on all four wheels from either end.

Petrol Inspection Car, North Eastern Ry.

The saloon is finished in mahogany throughout with brass fittings. The roof is of the clerestory type arranged with mechanical deck light ventilators. The petrol tanks are at one end suitably enclosed on the one side with a small lounge, and on the opposite side a large table with a hinged flap has been fitted for inspection drawings, writing, etc. Three large and six moderate sized arm chairs form the seating arrangement. Suitable trap doors over the engine and high tension distributor are located in the floor. The heating is by means of a vertical radiator placed at one end next the partition, the hot water from the engine being utilized. The lighting is electric, the storage system being employed, the accumulators being arranged below the under frame. The total seating accommodation is for 12 persons.

Personals

As noted in the May issue, John Purcell has been appointed assistant to the second vice president of the Atchison, Topeka & Santa Fe with office at Chicago, and

M. J. Drury.

will have charge of all mechanical matters. M. J. Drury succeeds Mr. Purcell as superintendent of shops at Topeka.

The Birmingham & Southeastern Ry. has acquired control of the Tallahassee & Montgomery Ry. and will operate it by and in the name of the B. & S. E. Ry.

F. J. Easly, J. B. Smalley and T. H. Beacom, general superintendents of the first, second and third districts respectively, of the Rock Island, have had their titles changed to that of assistant general manager.

Charles A. Allen has been appointed assistant to general superintendent Dunkle of the Erie, with office at Galion, O. Fred M. Hawley succeeds T. Mackrell as superintendent at Salamanca, N. Y. E. I. Bowen succeeds R. E. Woodruff as superintendent at Rochester, N. Y. W. J. English has been appointed superintendent at Jersey City, N. J., vice C. D. Taylor and A. E. Ruffer succeeds Mr. English as assistant superintendent at the same place. W. A. Baldwin succeeds E. I. Bowen as superintendent at Susquehanna, Pa.

Carl R. Gray, formerly president of the Spokane, Portland & Seattle and associated lines, succeeds Louis W. Hill as president of the Great Northern. Mr. Hill becomes chairman of the executive committee.

Carl R. Gray.

R. W. Baxter, formerly general superintendent of the Illinois Central, has been elected vice president of the Copper River & North Western with office at Seattle, Wash. He succeeds J. H. Young, who has been elected president of the Spokane, Portland & Seattle and other lines, to fill the vacancy caused by the resignation of Carl R. Gray. A. E. Clift succeeds Mr. Baxter as general superintendent of the Illinois Central at Chicago. J. F. Porterfield succeeds Mr. Clift as general superintendent at New Orleans, La. J. J. Gavin has been appointed superintendent at Carbondale, Ill., succeeding Mr. Porterfield. J. J. Pelley succeeds Mr. Gavin as superintendent at Fulton, Ky.

F. M. Graham succeeds F. D. Way as master mechanic of the Mason City & Clear Lake, with office at Mason City, Ia.

The Pennsylvania, in accordance with the prevailing custom has discontinued the practice of designating its vice presidents by number. Geo. D. Dixon has been elected vice president in charge of traffic, succeeding the late J. B. Thayer, who was lost on the Titanic.

F. M. Nash succeeds W. H. Lewis as master mechanic of the Texas State at Rusk, Texas.

E. D. Bronner, formerly superintendent of motive power

E. D. Bronner.

of the Michigan Central has been appointed general manager to succeed R. H. L'Hommedieu, resigned on account of ill health. His office will still be at Detroit, Mich. W. H. Flynn succeeds Mr. Bronner as superintendent of motive power with office at Detroit. E. R. Webb succeeds Mr. Flynn as master mechanic at St. Thomas, Ont., and W. H. Corbett becomes master mechanic at Michigan City, Ind.

H. H. Hale has been appointed superintendent of the car department of both the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton with office at Cincinnati. A. P. Prendergast, superintendent of motive power of the Baltimore & Ohio Southwestern at Cincinnati, has had his jurisdiction extended over the Cincinnati, Hamilton & Dayton. His office is at Cincinnati, O. John Hair, formerly superintendent of motive power of the Baltimore & Ohio Southwestern, has been appointed safety inspector of the Baltimore & Ohio with office at Baltimore, Md.

H. B. Voorhees has been appointed general superintendent of the Baltimore & Ohio and the Cincinnati, Hamilton & Dayton with office at Cincinnati, O. C. C. Riley succeeds Mr. Voorhees as general superintendent of transportation of the Baltimore & Ohio and the Baltimore & Ohio Southwestern with office at Baltimore, Md.

A. O. Garber has been appointed master mechanic of the Illinois Central at Paducah, Ky., succeeding W. H. Donley. W. J. Hoskin, recently with the Chicago & Alton, has been appointed assistant master mechanic of Paducah, Ky., shops of the Illinois Central.

B. A. Beland, master mechanic of the St. Louis & San Francisco, at Ft. Scott, Kan., has been transferred to Birmingham, Ala., and H. Honaker, master mechanic place, has been transferred to Ft. Scott.

The office of A. B. Appler, mechanical engineer of the Delaware & Hudson Co., has been moved from Green Island, N. Y., to Watervliet, N. Y.

D. G. Cunningham, formerly general foreman of the Norfolk & Western, has been appointed superintendent of shops of the Denver & Rio Grande with headquarters at Salt Lake City, Utah. W. O. Williams has been promoted to general foreman with office at the same place.

E. J. Chamberlin has been elected president of the Grand Trunk and Grand Trunk Pacific with headquarters at Montreal, succeeding the late Chas. M. Hays. Wm. Wainwright succeeds Mr. Chamberlin as first vice-president of the Grand Trunk Pacific and M. M. Reynolds has been elected second vice-president of the latter company.

H. Wanamaker has been appointed superintendent of shops of the New York Central & Hudson River at West Albany, N. Y., succeeding L. H. Raymond. J. G. Parsons succeeds Mr. Wanamaker as shop superintendent at Depew, N. Y.

W. C. Lambert has been appointed division fireman of the Oregon Short Line at Glenns Ferry, Ida. J. P. Worthley succeeds Mr. Lambert as general foreman at Montpelier, Ida.

Among The Manufacturers

Industrial Notes

The Duntley Pneumatic Tool Co., of Chicago, has been incorporated under the laws of Delaware by J. W. Duntley and his associates, with a capitalization of $100,000. The company has entered into a contract with the Gibbons & Lewis Co., of Fond du Lac, Wis., for the manufacture of a full line of pneumatic tools, and the Duntley Manufacturing Co. of Chicago will act as the selling agency.

The MacArthur Concrete Pile & Foundation Co., 11 Pine Street, New York, has been awarded a contract for 2,700 pedestal concrete piles, together with a large amount of concrete capping and similar work for the new Willerica shops of the Boston & Maine, North Willerica, Mass. Ten large shop buildings, covering about 150 acres, are to be constructed, and heavy locomotive and train loads are to be carried in a number of places.

John G. Platt has been promoted to sales manager of the Hunt-Spiller Manufacturing Corporation, with headquarters at 383 Dorchester Ave., Boston, Mass.

The Watson-Stillman Co., 50 Church St., New York, has chosen President E. A. Stillman, Vice-President and Secretary A. F. Stillman, Treasurer J. P. Bird, Chief Engineer Carl Wigtel, and Superintendent Frank Lary as directors. A new branch office is to be opened at Philadelphia shortly and shop facilities are being improved to meet increasing business.

Robert Law, formerly general manager of the Missouri lines of the Chicago, Burlington & Quincy, and more recently vice-president and general manager of the Colorado & Northwestern, has recently become connected with the United Car Co., of Chicago, as vice-president and general manager.

The Pressed Steel Car Co. has received an order from the Union Carbide Co., of Niagara Falls, for four steel hopper cars of 100,000 lbs. capacity.

The Titanium Alloy Manufacturing Co. has moved to 630-631-632 Oliver building, Pittsburgh, Pa.

Mr. J. M. Munroe, who formerly was general foreman of the Southern Ry., has accepted a position with the Hunt-Spiller Mfg. Corp. of Boston, Mass., as representative.

The Ashton Valve Co., of Boston, Mass., has moved its Chicago office from 166 West Lake street to 174 North Market street.

The Chicago-Cleveland Car Roofing Co. has moved its New York office to room 368, 50 Church street. Arthur S. Lewis has been added to the staff as eastern representative.

The Railway Construction Co. has been organized at Oklahoma City, Okla., for the purpose of general railroad construction work. The incorporators are Carlos Combs and L. Langford, of the Patterson Co., and E. L. Cole, a railway construction contractor.

Mr. Edward E. Wright has been appointed manager of the central sales district of the McKeen Motor Car Co., with offices in the Marquette Bldg., Chicago, Ill.

Clayton D. Walworth, formerly with the U. S. Wind Engine & Pump Co., Batavia, Ill., has been made manager of the Chicago office of the Q. & C. Co., New York. Henry A. Hawes, formerly in the sales department of the Railway Steel-Spring Co., New York, has gone to the Q. & C. Co., with office in New York.

The Walker & Bennett Manufacturing Co. has opened an office at room 1824, 30 Church street, New York City. The company manufactures all styles of car seats for railway and electric cars. Their new style of seat is made with a pressed steel pedestal, aisle and end plates, and arm rests.

The Zug Iron & Steel Co., Pittsburgh, Pa., has opened an office at Detroit, Mich., to handle its business in that district, including Cincinnati, Ohio, Cleveland, Toledo and Buffalo, N. Y. This office will be in charge of Edward A. Hawks as district sales manager. Mr. Hawks will retain his position as representative of the Beaver Dam Malleable Iron Co., Beaver Dam, Wis.

New Literature

The Chicago Pneumatic Tool Co., of Chicago, has issued folder No. 102, descriptive of a few of the various styles of drills made by this firm.

* * *

The April number of American Vanadium Facts, issued by the American Vanadium Co., of Pittsburgh, contains an account of the discovery and development of this metal. In conclusion, it says, "Vanadium is the only element that greatly increases the elastic limit and dynamic strength of steel without impairing its ductility."

* * *

A very attractive booklet dealing with the Damascus Bronze Co., of Pittsburgh, and its products has just been published by that firm. The reading matter and illustrations are instructive and in good taste.

* * *

A Westinghouse type T direct-current turbo-generator is fully described and illustrated in leaflet 2458 just issued by the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. This company has also recently issued a number of leaflets dealing with its latest types of railway motors.

* * *

Catalogue No. 6 of the Gem Mfg. Co., Pittsburgh, Pa., contains complete descriptions and price lists of all varieties of steel and brass oilers, and flexible shafts.

* * *

"Hydraulic Benders" is the title of a new 64 page catalogue devoted exclusively to hydraulic machines just published by the Watson-Stillman Co., New York. Hydraulic benders are now commonly used for bending all kinds of rails, structural shapes, reinforcing rods, and pipe; for shaping automobile frames; for straightening rods or shafts while held between lathe centers, and in almost every other conceivable place where heavy bending is to be done.

* * *

The Hohmann & Maurer division of the Taylor Instrument Companies, Rochester, N. Y., has issued two interesting booklets, the first on the subject of "Recording and Index Thermometers," the second on "The Control of Temperature."

* * *

The United States Electrical Tool Co., of Cincinnati, O., in catalogue "H" shows a complete line of electrical hand or breast drills. These drills operate on either direct or alternating current and may be plugged into any incandescent lamp socket. The casings of these drills are of aluminum, making them light in weight, and they are easily controlled by a switch in the handle.

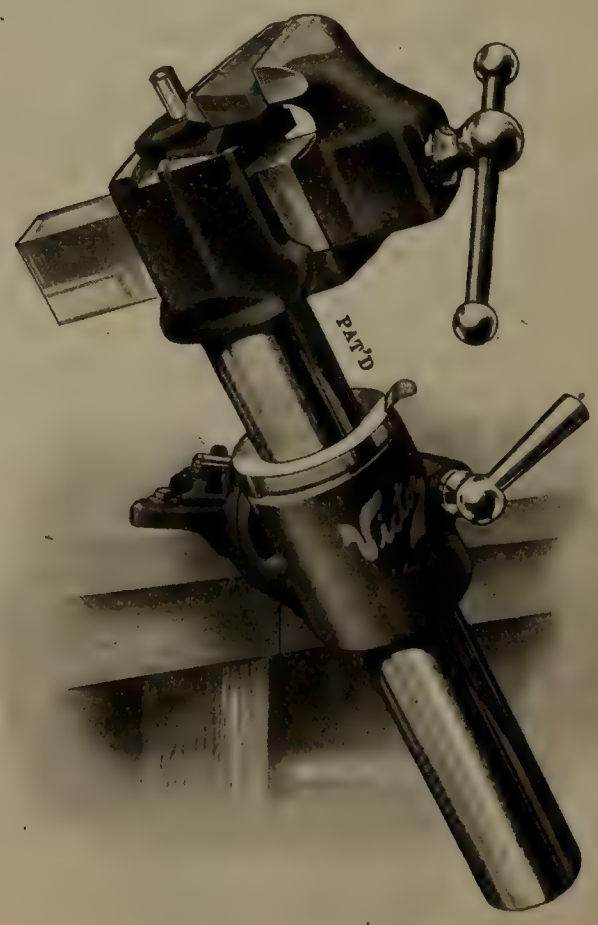
* * *

The special railroad department catalogue issued by the Carborundum Co., Niagara Falls, N. Y., gives complete details regarding grits and grades of wheels recommended for the different classes of work.

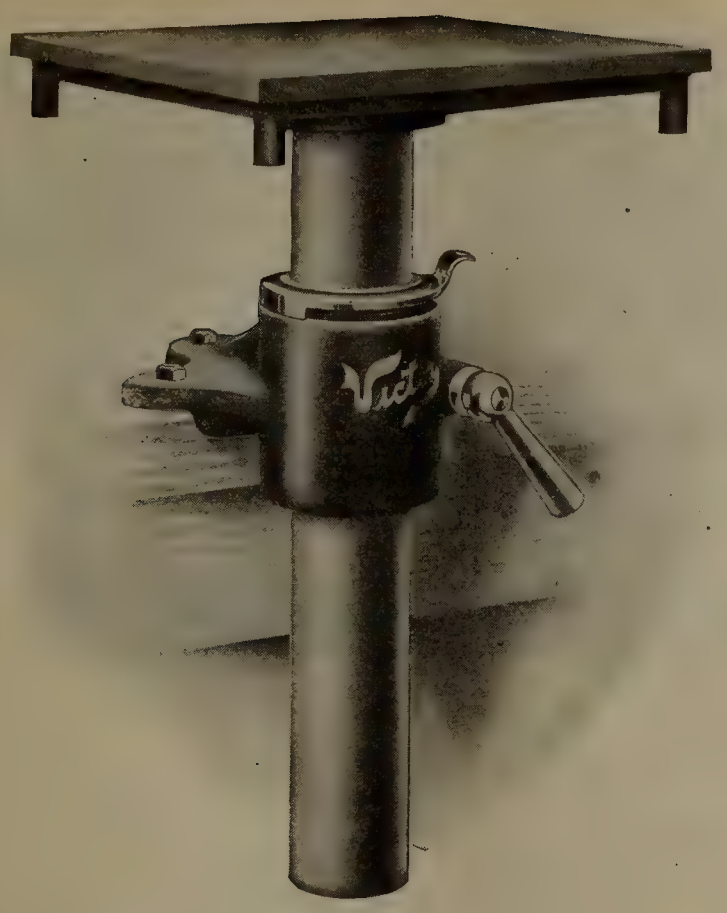
P. J. Mitchell, B. E. D. Stafford and J. D. Conway at Atlantic City, March 19, 1912.

UNIVERSAL VISE AND SURFACE TABLE.

The vise illustrated has a universal adjustment which makes it possible to hold odd-shaped parts, as well as ordinary shapes, in the best position for the workman. The swiveling base gives an angular adjustment and the vise can be raised or lowered to the most convenient height. The vise can also be turned about the axis of its supporting column. These various adjustments enable the workman to secure the best light on



Vise with Universal Adjustment.



Surface Table Mounted on Vise Base.

lines or prick-punch marks indicating finished surfaces, and they also prevent stooping or working in an awkward attitude, as is often necessary with the ordinary fixed vise. The vise is rigidly held in any position by a single clamping lever, and when a vertical adjustment is made, the vise is held automatically until the lever is tightened by a locking collar on the stem. These vises are made in four styles and four sizes.

An accessory to this vise is also illustrated. This is a surface-table or plate which can be mounted in the base as shown. This plate can also be detached from the stem and used on the bench, the same as an ordinary surface-plate. The sizes of these plates are made to suit individual requirements. These vises and surface-tables are the product of the Victor Vise Co., 15-19 W. Washington street, Springfield, O.

NEW TUBE CLEANER.

Joseph T. Ryerson & Son has placed upon the market the new Matthews tube-cleaning attachment specially designed to be used in connection with the Ryerson tube-cutting machine. This combination for tube cleaning and tube cutting gives the shop two complete machines for scarcely more than the price of one and which only requires the working space of one.

One passage through the cleaning burrs finishes the cleaning, the tubes traveling about ten feet per minute. The scale is thoroughly scoured off the tubes without the damage due to denting or chipping.

The essential elements are the friction wheel and the adjustable twin roller cleaning burrs, which are built up of hardened serrated steel discs. These twin roller cleaning burrs are assembled in a unit which is readily interchangeable with the roller tube support employed when the machine is used for cutting tubes. Hence, only two changes are required to change the cutting machine over to a cleaning machine: (1) replace the cutting disc with the friction wheel, and (2) replace the tube support with the cleaning burrs.

When used for cleaning the longitudinal travel of the tubes is effected by adjusting the roller support slightly out of square; the direction of travel and the rate of speed being determined by angle of divergence.

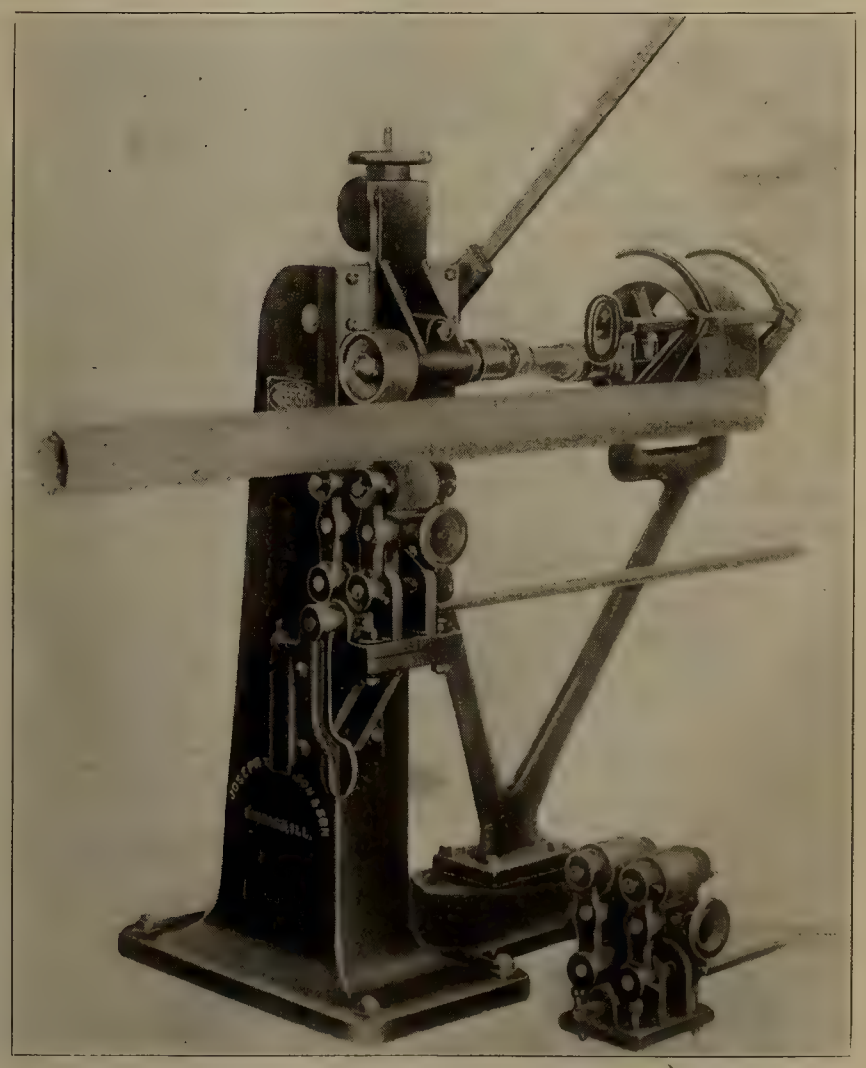
When equipped for cutting tubes this machine is designed to meet the requirements of the general run of shop work, and handles tubes from ⅜-inch to six inches in diameter. The design is simple, substantial and compact. There is practically nothing to become worn or to get out of order. The main spindle bearing is turned from the best quality of bronze and the driving shaft bearing is lined with high-grade "Glyco" Babbitt metal.

Noiseless running is assured by the use of a universal shaft for connecting the driving shaft with the main spindle, which does away with all gearing and consequent noise. The cutting disc is 4½ inches in diameter and is secured on the main spindle which rotates in the vertical sliding head. The feed of the cutting disc is controlled by means of the counterbalanced hand lever. The convenient position of the taper reamer opposite the cutting disc is an important feature of the design of this machine.

PITTSBURG STEEL FOUNDRY CO.'S CAST STEEL TRUCK FRAME.

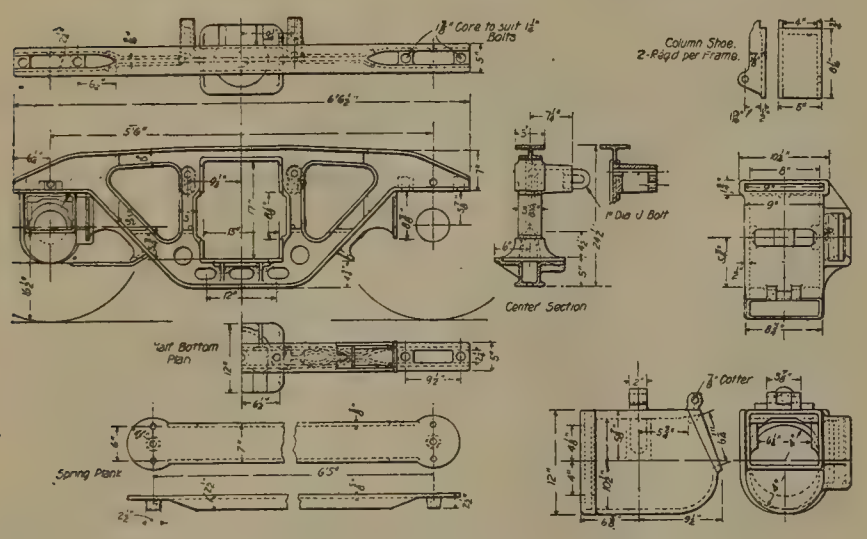
The use of cast steel in the manufacture of truck frames has inspired considerable variety in design, the two general types of which heretofore have been those using standard journal boxes, with some form of tie bar and box bolts, and that type in which the boxes and frames are cast integral. While both types have their advantages, the first class having the advantage of ready repair in case of damage to boxes and the second a very considerable advantage in weight, each is objected to for the lack of the merits possessed by the other.

A third design has lately been brought out by the Pittsburg Steel Foundry Co. that is a compromise between the first two in that it combines the best points of the others and eliminates most of their objectionable features. This has been accomplished by the use of a special journal box, which, as will be seen, must be cast in lefts and rights, with



Tube Cutter with Cleaning Attachment.

Composite Gondola Car, G. & P. R. R.



Details of Cast Steel Truck.

a pocket on one side to receive a lug on the frame. A lug on top of the box extends up between the vertical members of the frame at each end, through which a pin is placed, holding the box in position without the use of the usual tie bar and box bolts—the latter being used in any event only as a means of adapting the standard box to the cast steel frame. Provision has been made by coring bolt holes in the frame and by means of a short tie bar, whereby the standard box can be applied to this frame, although such arrangement is meant to be used only in case of emergency.

One of the illustrations herewith shows this type of truck frame applied to one of a lot of ore cars built by the Western Steel Car & Foundry Co. for the Gilmore & Pittsburg road. Other interesting features of these trucks are the cast steel truck bolsters and the interlocking cast steel spring planks, making, what is said to be, the first car built in this country having an entirely cast steel truck.

This construction has been mainly used on the Gilmore & Pittsburgh R. R., and by the Cudahy Packing Co. It is said to be regarded as a success by these car lines. This would seem to indicate that it will become one of the standard trucks for railways of the United States.

FORCE FEED LUBRICATION.

The McCord system of locomotive force feed lubrication is designed on the theory that the most efficient method of lubricating the locomotive is to deliver the lubricant automatically, positively and in proportion to the work the locomotive is performing. The system is applicable to valves, cylinders and air pumps using valve oil and to driving boxes using engine oil, or to both, actuated by the same or differently arranged driving mechanism with the two different oils partitioned off in the same reservoir, or with the different oils in different reservoirs to suit the peculiarities of different types of locomotives.

The figure illustrates the general application for lubricating air pumps, valves, cylinders and driving boxes. The transformer (3), which changes the motion from reciprocating to rotating, is connected by rod (4) to the cross head lever of the Walschaert valve gear. This can be attached to any moving part of any valve gear. In this manner the transformer lever is moved in proportion to the valve travel, which in turn actuates the rotating rod (2) which through universal joints transmits this motion to the lubricator proper in proportion to the valve travel. The oil pipe for the valve, cylinders and air pump is run in the usual way under the jacket, and the oil pipes to the driving boxes are run, as shown, with flexible steel tubes (8), leading from the pipe attached to the frame, to the driving boxes through check valve (9).

With this method of lubrication it has been possible to run a set of valve packing rings on a superheater engine 155,000 miles before renewing. The driving boxes and brasses ran the same length of time, and at this general overhauling, after 155,000 miles, it was not necessary to touch a tool to the driving boxes, in fact the boxes were put back the same way they were taken off, and it is not known what the ultimate record will be. With this method of lubrication it is possible to save a ton of coal for every four-hour run of one of the large modern passenger en-

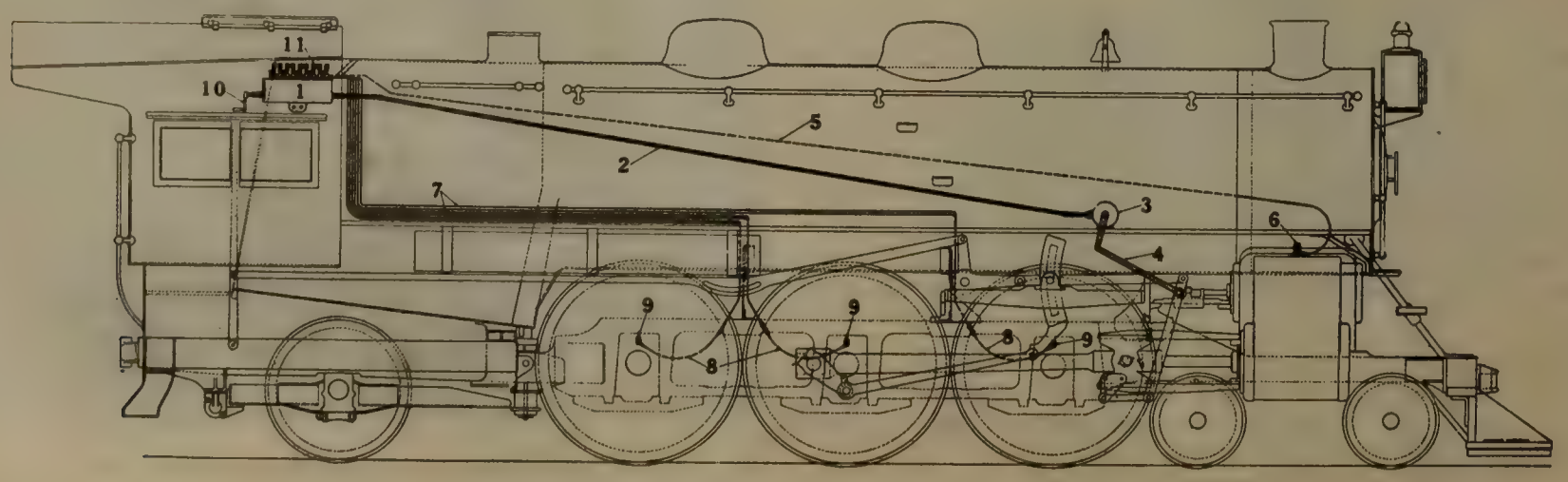


Diagram Showing McCord System of Lubrication.

Fig. 1—Tempering Plant for Blue Chip Steel.

gines. It is an easy matter to reduce oil consumption 35 per cent and increase engine efficiency 10 per cent.

Where a passenger engine equipped with other means of lubrication could just make the time with a nine-car train, it was found it could make the time with a 10-car train when equipped with the force feed system.

The system with the assistance of working models will be exhibited at McCord & Company's booth, Nos. 511 and 513, Atlantic City Convention.

BLUE CHIP STEEL.

In the sixteen years since the organization of the Firth-Sterling Steel Company it has grown from a small plant to one of the largest tool steel companies in America. The product of this company is exclusively high grade tool steels.

"Blue Chip" Steel is probably the most widely known of the Firth-Sterling brands, as it was one of the first high speed steels to be put on the market. The quality has been improved constantly and with every improvement the field of usefulness has been extended. Today it is being used for nearly every class of cutting tools except those subject to rapid vibration or violent concussion.

To extend the use of Blue Chip steel the Firth-Sterling Steel Co. maintains demonstrating tempering plants in New York, Boston, Philadelphia, and Chicago. In these plants customers can see Blue Chip treated by the most approved methods and with the best possible facilities. This policy has made possible the use of Blue Chip steel for numerous purposes where high speed steel has hitherto been considered impractical. Figure 1 gives a view of one end of the Chicago tempering plant, showing furnaces of various types, among which there is always one suited to the tool no matter how unusual it may be.

At the top of figure 2 are two 9½ in. dia. x 2 in Blue Chip milling cutters of rather an unusual type. They were designed by T. Helgren of the Aurora shops of the C., B. & Q. Ry., for fluting locomotive side rods. These cutters were hardened in the Chicago tempering plant about five years ago and are still in service, proving that it is true economy to buy a high grade steel to start with. The tools in the center of figure 2 are wood cutters. At first thought it would not seem profitable to use Blue Chip for cutting wood but these cutters have proven highly satisfactory. The bottom of figure 2 shows a miscellaneous assortment of milling cutters, covering a wide range of work.

Figure 3 shows a number of 30 in. Blue Chip reamers and some 42 in. staybolt taps, both of which were tempered by the Barium Chloride process. This process has been developed by the Firth-Sterling Steel Co. for the treatment of taps, dies, reamers, drills, threading tools, cutters and other tools where it is desired to have the work come from the tempering with sharp edges, points intact, and no perceptible loss in size. Anyone who has had experience in the treatment of tools similar to those shown in figure 3 appreciates the difficulties in the way of bringing them out straight, without any change in size and with the points and edges perfect.

This company through its tempering plants and research department has been largely instrumental in the introduction of high speed steel for fine tools. This is particularly

Fig. 2—Blue Chip Steel.

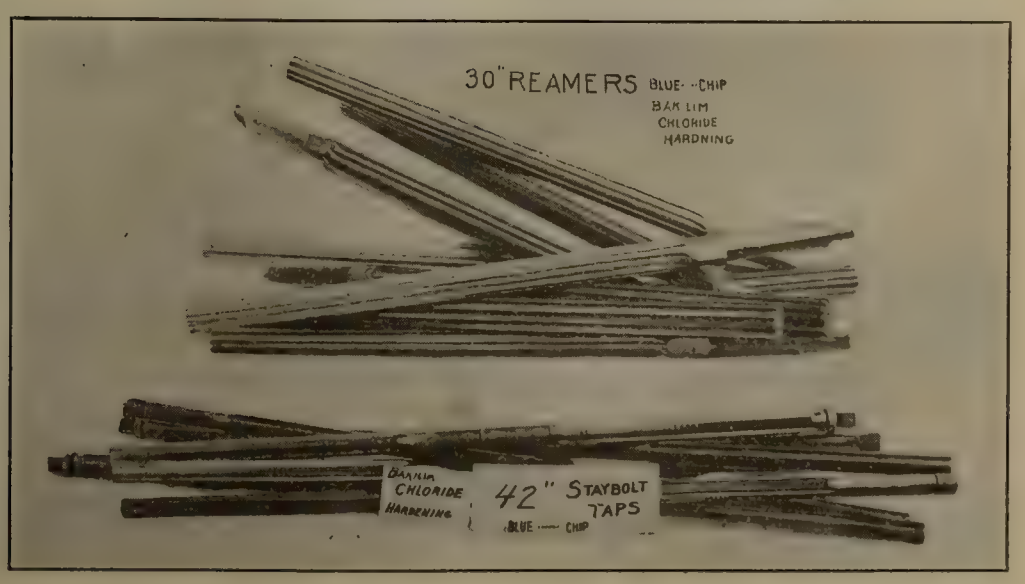


Fig. 3—Blue Chip Steel.

true of railroad shop tools such as engine frame reamers, crosshead reamers, staybolt taps, milling cutters, etc.

EDISON-BEACH CARS.

The Railway Storage Battery Car Company has been organized by F. J. Lisman & Co. and associates to finance the output of the Federal Storage Battery Car Company, which operates a large plant established at Silver Lake, N. J., engaged in the manufacture of railway cars equipped with the Edison Storage Battery for operation over steam and electric railroads. The Federal Storage Battery Car Company has the exclusive right to the use of the Edison storage Battery is now guaranteed to maintain its full no storake battery as applied to railway cars and the Edisc mal original capacity for four years. This company built its first car three years ago. This car was put into operation in New York City and the second car was purchased by the Suffolk Traction Co. at Patchogue, Long Island, which company has just received the third car ordered from the Federal Storage Battery Car Co. as the result of the successful and consistent performance of the first cars. Other Beach cars have been in operation for a year or more and have met with success and satisfactory service on a Branch Line of the Penna. R. R., the Long Island Railroad and the lines of the New Castle & Delaware City Traction Co., Peoples Electric Railway Co., at Muskogee, Okla., at Rock Hill, S. C., and a good many other towns in North and South Carolina, Billings, Mont., and many other localities. Cars have already been exported to Japan, New Zealand, Australia and South America and a three car train is under construction for the United Railways of Havana, Cuba, and other cars of various types are now being built for the Chicago Great Western, Chesapeake & Ohio, Cambria and Indiana, Tanana Valley Railroad (Alaska), Willimette Valley and Coast R. R. (Oregon), etc. These cars, it is said, are especially adapted in point of economy and maintenance and cost of operation in suburban and branch line service on steam railroads, and as they save the expensive overhead construction and costly power plants of overhead trolley roads, they are said to be much more satisfactory and economical under many conditions of service and operation than the trolley car.

T. D. Rhodes, vice president of the New York, Westchester & Boston Ry. Co., and receiver of the Detroit, Toledo and Ironton Ry. Co., retires from his connection with these properties to become president of the new organization, the Railway Storage Battery Car Company.

NEW PLANT OF FRANKLIN MFG. CO.

The accompanying illustration shows one of the plants of the Franklin Mfg. Co. of Franklin, Pa. This company has for the past fifteen years been providing asbestos supplies, magnesia products, cotton and wool waste for railways, and the recent completion of a new plant for the manufacture of 85 per cent magnesia boiler lagging and coverings, located at Stoneboro, Pa., adds to the output of the concern very materially. This new plant is one of the largest now in existence running exclusively on 85 per cent magnesia sectional boiler lagging, pipe coverings, and cement.

The buildings are of steel and concrete construction, fireproof throughout and are equipped with the latest and most modern type of electrically-driven machinery incidental to the manufacture of these commodities. The Franklin Mfg. Co. controls the quarries where the dolemite rock is mined from which these magnesia products are manufactured, also the coal mines to supply fuel for the new plant. The plant is located on both the lines of the L. S. & M. S. R. R. and on the Pennsylvania thus giving adequate shipping facilities.

This company also operates, at the present time, in Franklin, Pa., a large plant running exclusively on the manufacture of asbestos supplies of all natures and has won an unusual reputation for itself from the manufacture of its asbestos lumber smoke jacks. These jacks are fireproof and light in construction and are very durable.

Aside from operating the asbestos mill and the new magnesia plant, The Franklin Manufacturing Co. also operates one of the largest plants in this part of the country, running on cotton and wool waste of all descriptions as well as the "Perfection" journal box packing which is well known, as many of the railways are using it throughout.

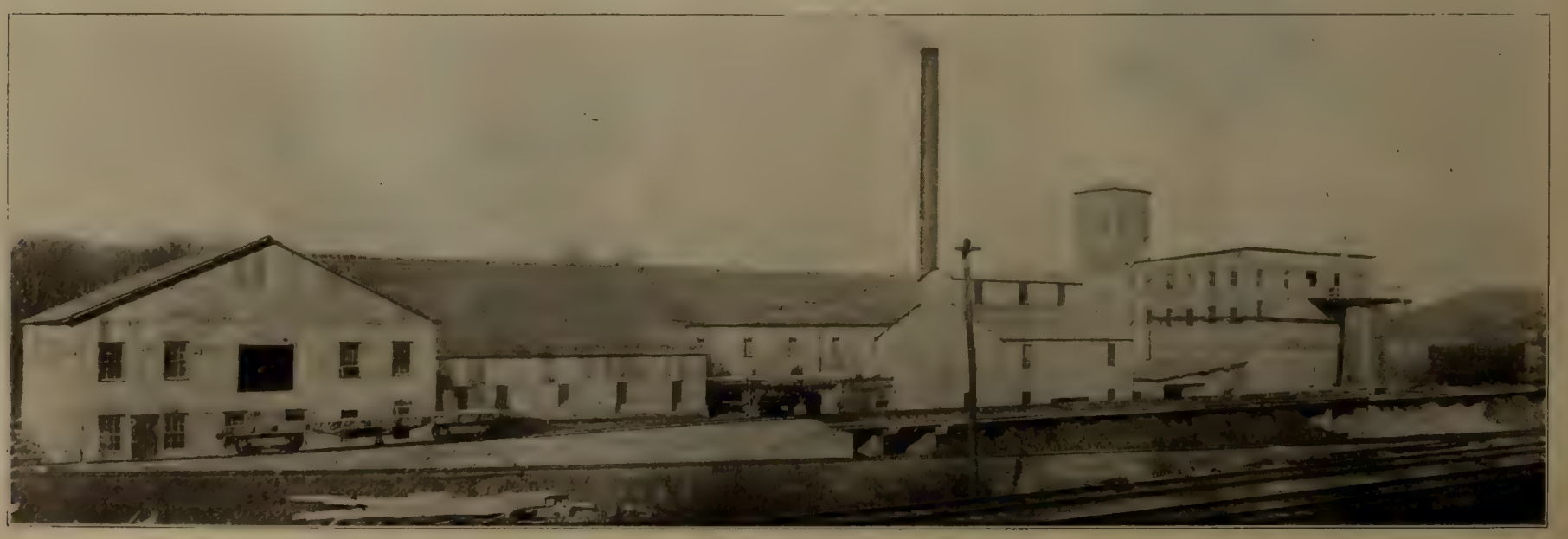
J. E. Chisholm, formerly in charge of sales of the Chicago Steel Car Co. and at one time at the head of the mechanical department of the Chicago Great Western, has opened a railway supply office at 355 Old Colony Bldg., Chicago.

The Oregon & California is planning to construct a 25-mile line up the South Santrain Valley from Lebanon to a point above Foster. Surveys for this line have been made and it is probable that construction work will be started soon.

The Paris & Mt. Pleasant will let contracts soon for the construction of a 27-mile extension from Bogota to Mt. Pleasant.

The Pecos Valley Southern has under consideration a proposition to build a branch from Saragosa, Tex., southeast to Fort Stockton, about 60 miles. Extensions are also planned from Pecos northerly to Lubbock, about 200 miles, and from Balmorhea south to Alpine, about 50 miles. It is said that work will be started soon on both these extensions.

The St. Louis, Brownsville & Mexico is planning to build a branch, it is said, from Heyser, Tex., on the Port O'Connor branch, to Austwell on San Antonio bay. Surveys are now being made, and construction work will be started soon.



Stoneboro Plant, Franklin Mfg. Co.

A TRIBUTE TO JOSEPH DIXON.

"Elbert Hubbard, the sage of East Aurora, has compiled a list of the world's twenty greatest men about which he has built an essay.

Mr. Hubbard's essay is done into book form by the Roycrofters and the title is "Joseph Dixon, One of the World Makers."

Mr. Hubbard refers to Joseph Dixon as "a man whose work has profoundly influenced civilization, yet strangely enough, a man of whom the world at large knows little."

This tribute to the founder of the Dixon company is well worth reading, especially by those who wish to learn more of the character of this truly great genius or by those who admire Mr. Hubbard's vigorous pen.

Owing to a limited edition of this booklet, copies cannot be distributed except by request. The Joseph Dixon Crucible Company, Jersey City, N. J., will be glad to honor such requests.

It is reported that the Atchison, Topeka & Santa Fe has let the contract for the construction of the first 6 miles of double track between Keenbrook and San Bernardino, Cal. Work will be started at once.

The Boston & Maine has let a large contract to Holbrook, Cabot & Rollins for building a new line on the New Hampshire side of the Connecticut River between Hinsdale, N. H., and Brattleboro, Vt. The new line will be about ten miles long.

It is rumored that the New York, New Haven & Hartford is considering a number of improvements at Tarrytown, N. Y.

It is reported that contracts will be let shortly by the Northern Pacific for the construction of the proposed cutoff line from Linton through LaMoure, Emmons and Logan counties, N. Dak.

HIGH DUTY LATHE.

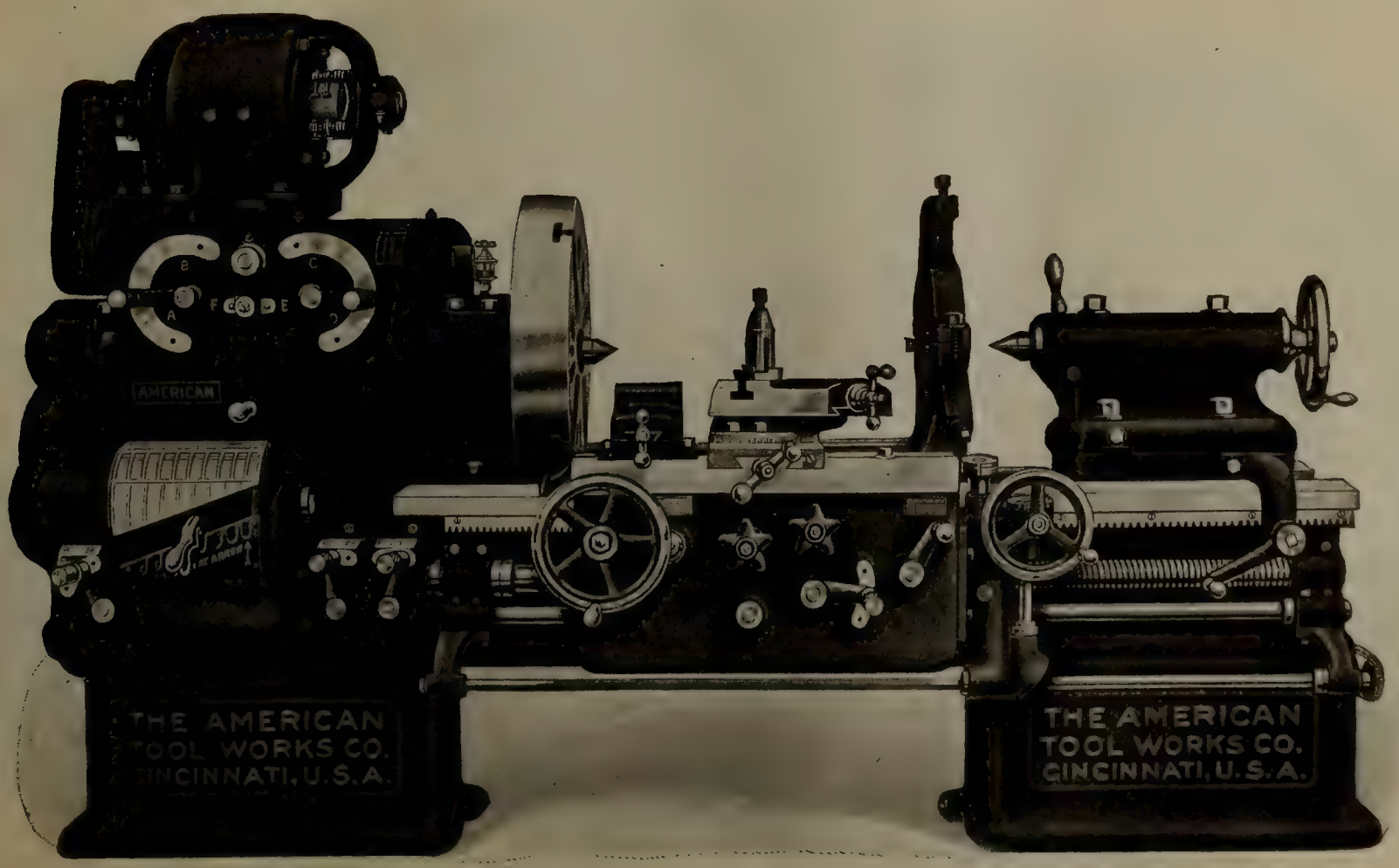
A new "American" 24-in. high duty lathe is being built by the American Tool Works Co., of Cincinnati, the two most prominent features of which are its capability of transmitting unusual power and its quality of workmanship. A clearer conception of the power one of these new 24-in. geared head lathes will develop may be gained from the fact that during a test made recently on this size machine for a representative of the Cincinnati Milling Machine Co. it removed machinery steel at the rate of 837 lbs. an hour. All parts of the lathe are machined to jigs, the spindle nose and face plate are chased to hardened and ground masters, the lead screw is chased from a Brown & Sharpe master screw and all alignments are guaranteed to be within .001 part of an inch.

The head affords eight spindle speeds through the medium of only 11 gears, two frictions and one jaw clutch. The speeds are produced in geometrical progression and cover a wide range from 7.3 to 270 R. P. M. All gears are of unusually wide face, are cut the coarsest pitch practical with special cutters, and are tested for accuracy on a special gear tester.

Of all the new features, the one which presents the most radical change in design from other similar mechanisms is the thread cutting and feeding mechanism. It is of the cone and tumbler type, and embodies only seventeen gears and three levers, and produces forty-eight changes for threading and feeding.

The non-speeding up feature enables the power to be transmitted direct through the cone for cutting the coarse threads and feeds, and thus eliminates the necessity of speeding up this mechanism by compound gearing to obtain sufficient speed to the lead screw to cut the coarse threads. The advantage of this is that in cutting the coarse threads when the greatest power is required the drive is direct and consequently a minimum of power is lost in transmission. In many designs it is necessary to speed up by compounding in the box to obtain sufficient speed for the coarse threads. This design also avoids a complicated mechanism with its consequent annoyances.

The tailstock has been made unusually rigid. It is of the four bolt type, the back belts extending to the top of the barrel while the front bolts extend only a trifle above the base of the tailstock. This construction makes it very convenient for the operator when clamping the tailstock to the bed. The rigidity of the tailstock is further increased by being supplied with a pawl which is dropped into a rack cast through the center of the bed. The tailstock *barrel is solid* and is supplied with an improved form of plug binder for clamping the spindle.



American 24-inch High Duty Lathe.

"ECKERT" CAR WATER CLOSET.

The "Eckert" car water closet, made by the Dayton Manufacturing Co., of Dayton, Ohio, possesses many valuable features, which are responsible for its adoption as standard by a rapidly increasing number of the large railway systems of the country. It is economical in operation, requiring a minimum quantity of water. It is strongly constructed and simple in design. It is suitable for either gravity or air pressure systems. Should the water supply fail it may be, without the use of any tools, changed to operate as a dry closet. Normal operation may be as quickly resumed.

The Eckert closet may be placed at any angle with the wall without requiring special fittings. The hopper is made of either white enameled cast iron, or of vitreous earthenware. Ample clearance is provided between the hopper and the walls of the apartment for heater pipes, etc. The woodwork is highly finished natural mahogany or quarter sawed oak. The trimmings are cast bronze heavily nickel plated and polished.

The Eckert closet is especially recommended for postal cars, as it will meet the new regulations of the department of Railway Mail Service.

The Dayton Manufacturing Co. also manufacturers "Dayton" car furnishings of every description, including bronze and brass hardware, headlights and signal lamps, oil, electric and gas car lighting fixtures, basket racks, sash locks, etc.

HISEY-WOLF MACHINE COMPANY.

For nearly a quarter of a century the Hisey-Wolf Machine Company, Cincinnati, O., has devoted its time and energies to the design and economical manufacture of high grade electric machine tools.

The company makes various types of drills, grinders, barrel head planers, glass blocking and marble polishing machines.

One of the illustrations shows a "Hisey" direct current, single speed, Scotch radial drill, the view showing the drill cutting 3½ in. holes in boiler plate.

These tools have decided advantages over a stationary radial, as they can be set up anywhere, and their range of work is unlimited. They are made with single or two speed gears.

The driving power may be obtained from any ordinary incandescent lamp socket, and any length of cord may be used.

The drill is provided with a 12 in. feed through the hand wheel, with a quick return by hand. It has a radius of 24 in. in any direction at any angle. The hand wheel and worm box have a swivel adjustment from horizontal to vertical, permitting use of drill in corners and close places. The columns are made of steel tubing, with a rack and pinion horizontal adjustment, and a vertical adjustment by means of a screw.

The motor is enclosed, dust-proof and air-cooled brush-holders and all wire connections enclosed, gears separately encased running in grease. The spindle is fitted with a ball thrust bearing, carrying a taper socket, all working parts especially hardened.

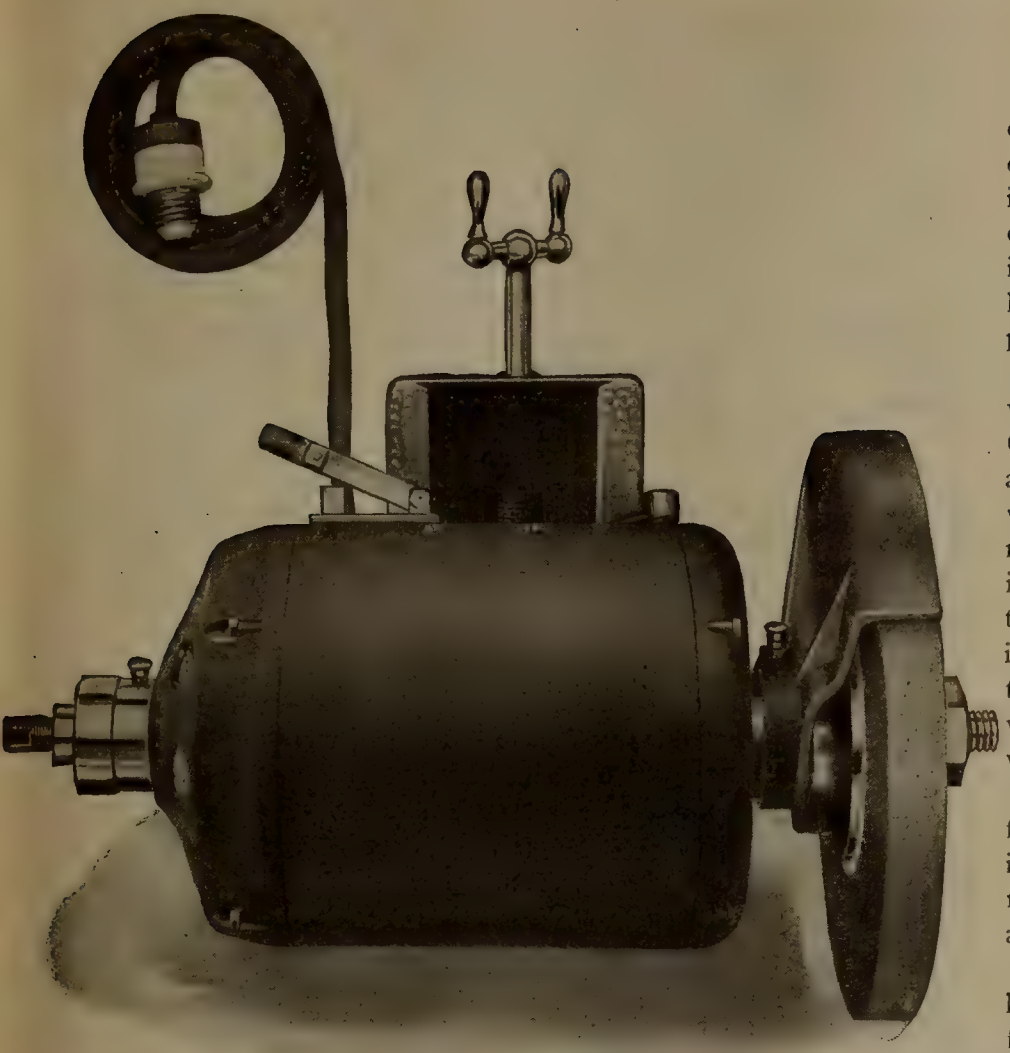
The dimensions of this tool are 7½ x 30 in., weight 174 lbs., capacity 1¼ in. in steel, and speed 150 revolutions per minute.

Another illustration shows a direct current "Hisey" parallel grinder. This is an efficient portable tool designed for heavy parallel grinding. It is particularly adapted for grinding rolls, journals, bushings, crank shafts, connecting rods and hardened work of all kinds. The case of the angle plate is bolted in tool-post rest of lathe. It has a vertical adjustment of four inches to bring it in line with the centers. It can be used to great advantage in a planer for surface grinding.

The motor is wholly enclosed, guaranteed dust-proof, has air-cooled, bearings and is adjustable to wear. It is burnished with a shank attachment if desired.

The dimensions are 7½ x 13¼ in.; the weight is 80 lbs.; It has one horse power at 200 r. p. m., size of emery wheel, 10 in. x 1 in. x ¾ in. hole.

Plant of Hisey-Wolf Machine Co.



Hisey Parallel Grinder.

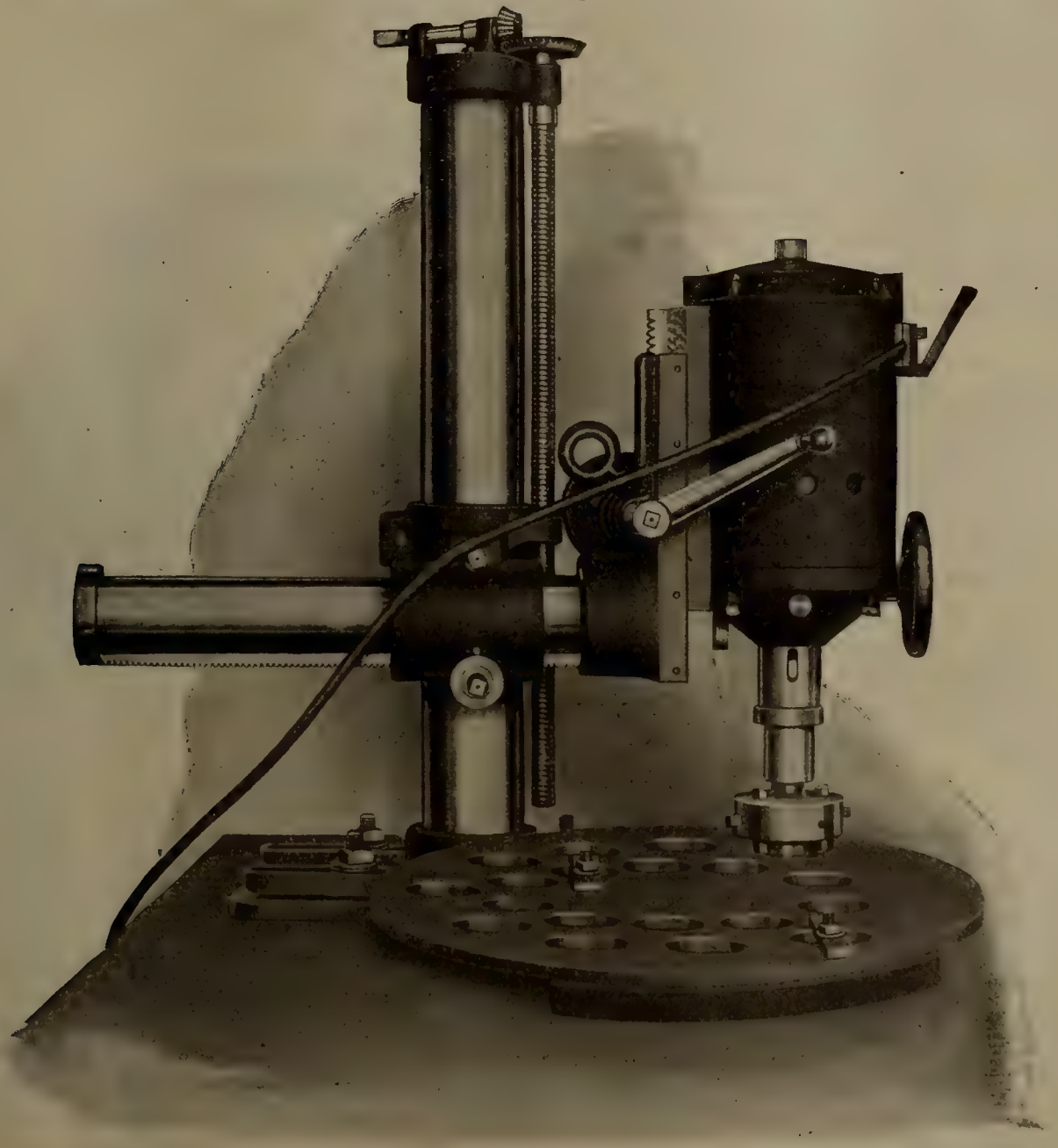
CARBORUNDUM AND ALOXITE GRINDING RECORDS.

As a rule the master mechanic and the shop superintendent is not at all anxious to know what a wheel is made of or how it is made. The thing that he is most interested in is what will the wheel do. He is anxious to know if it will do better work in less time, if it will cut fast and clean, if it will show long life. In other words, he is anxious to know if it will prove to be the right wheel in the right place.

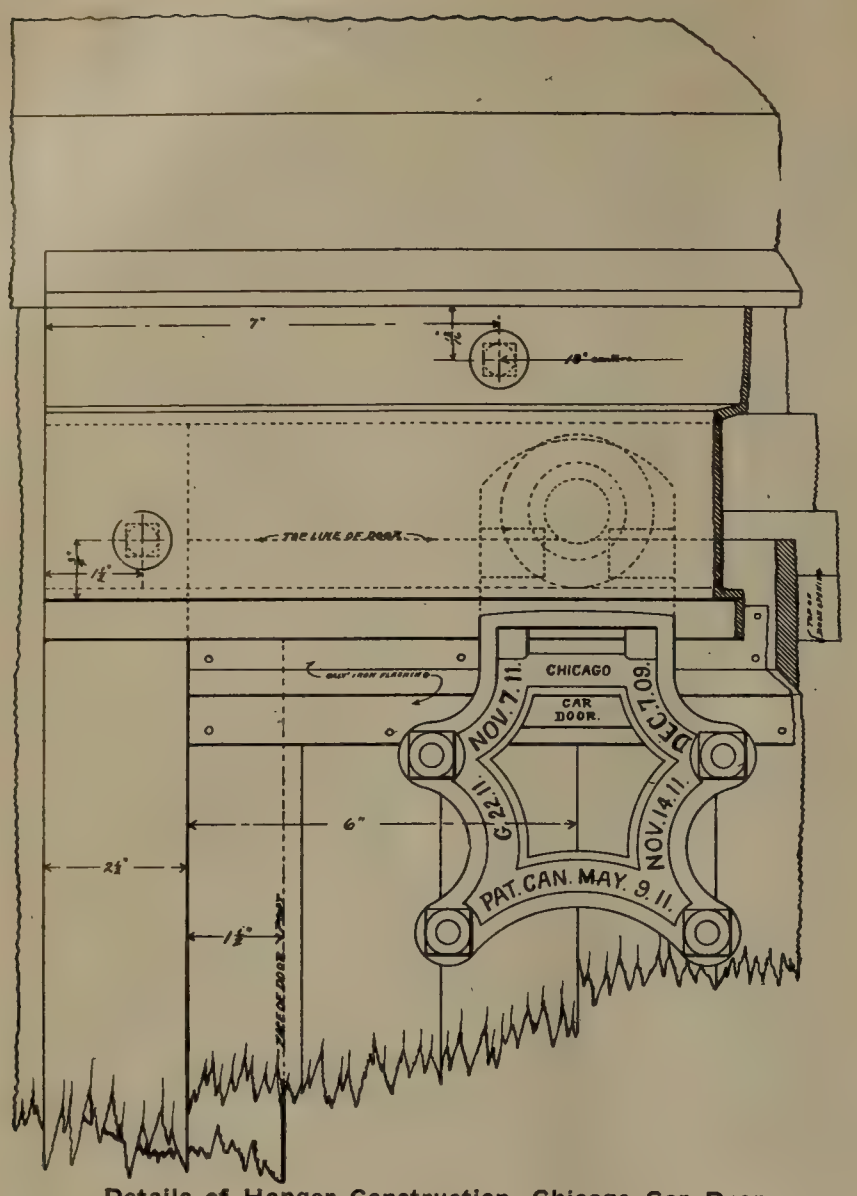
In talking of the merits of Aloxite or Carborundum wheels, or in advertising, it has become the policy of The Carborundum Company, so far as is possible, to give facts and figures regarding the actual records made by these wheels under the ordinary every day shop conditions. This means that the master mechanic or the shop superintendent is placed in a position to know just what has been done with these wheels and to compare records with the results he is getting with other wheels in his shop. This information has in many cases proven of decided value to the man whose duty it is to get the best possible grinding results with the least expenditure of time and money.

It will be of interest at this time to give some facts and figures regarding the records being made by these wheels in railroad shops in all parts of the country. These are records of every day work under ordinary conditions and are not the results of special tests.

A tool room foreman in one of the large railway shops has had a 10-inch Aloxite wheel on one spindle for over five months and in that time it has only lost 2 inches and has never had to be touched with a dresser. With this wheel he ground two 2¼ inch drills of mushet steel from the rough and the wheel only lost $\frac{3}{16}$ inch. These drills were



Hisey Radial Drill.



Details of Hanger Construction, Chicago Car Door.

made in the blacksmith shop twisted from plain stock and the wheel ground the flutes, shank and relief. The drills were 26 inches long and the wheel ground both perfectly.

In this same shop a 12 inch Aloxite wheel was used for cutting off mushet steel. A piece 2¼x⅝ inches was cut in 55 seconds and the wheel showed no appreciable loss. This same wheel he also used in cutting and grinding flutes in reamers. In cutting off mushet steel, a competing wheel took three minutes to make one cut and wore completely out after five cuts.

For reamers, cutters and general high speed steel tools for general steel grinding and for saw gumming, Aloxite wheels are making similar records in nearly every big shop in the country—records for clean, cool, fast cutting and for durability.

Carborundum grinding wheels have practically been without a rival for the grinding of car wheels as the following records will show. In one big shop where carborundum wheels were used for car wheel grinding the superintendent is said to have found that it costs his road less than one cent for every car wheel ground. One report submitted from this shop showed that 28 carborundum wheels ground 54,456 car wheels. In another shop one carborundum wheel ground 1,348 car wheels before wearing out.

These are records of efficiency and economy that the master mechanic cannot well afford to overlook. Carborundum wheels are as efficient in the railroad shop foundry in the grinding of cast iron, brass, bronze, aluminum and for general machine shop work.

Shop conditions, of course, in a great many cases govern the actual amount of work produced with a wheel. Different methods of handling the work, widely varied types of grinding machines and other conditions have an important bearing upon the final results. The aim and study of The Carborundum Company is to meet these varying conditions and to furnish wheels that will turn out enough work and better work to make the use of Carborundum or Aloxite wheels an economical proposition. A long and varied experience in all classes of grinding has made it possible for this concern's grinding experts to render valuable aid to the master mechanic in furnishing the right wheel in the right place.

A practical working exhibit of The Carborundum Company is located in booths No. 149-151 in Machinery Hall, Atlantic City. There wheels may be seen working under practical shop conditions. The exhibit is equipped with a universal grinder, a heavy floor grinder, a drill grinder and a cut-off machine, in constant operation demonstrating the results to be obtained with Carborundum and Aloxite wheels.

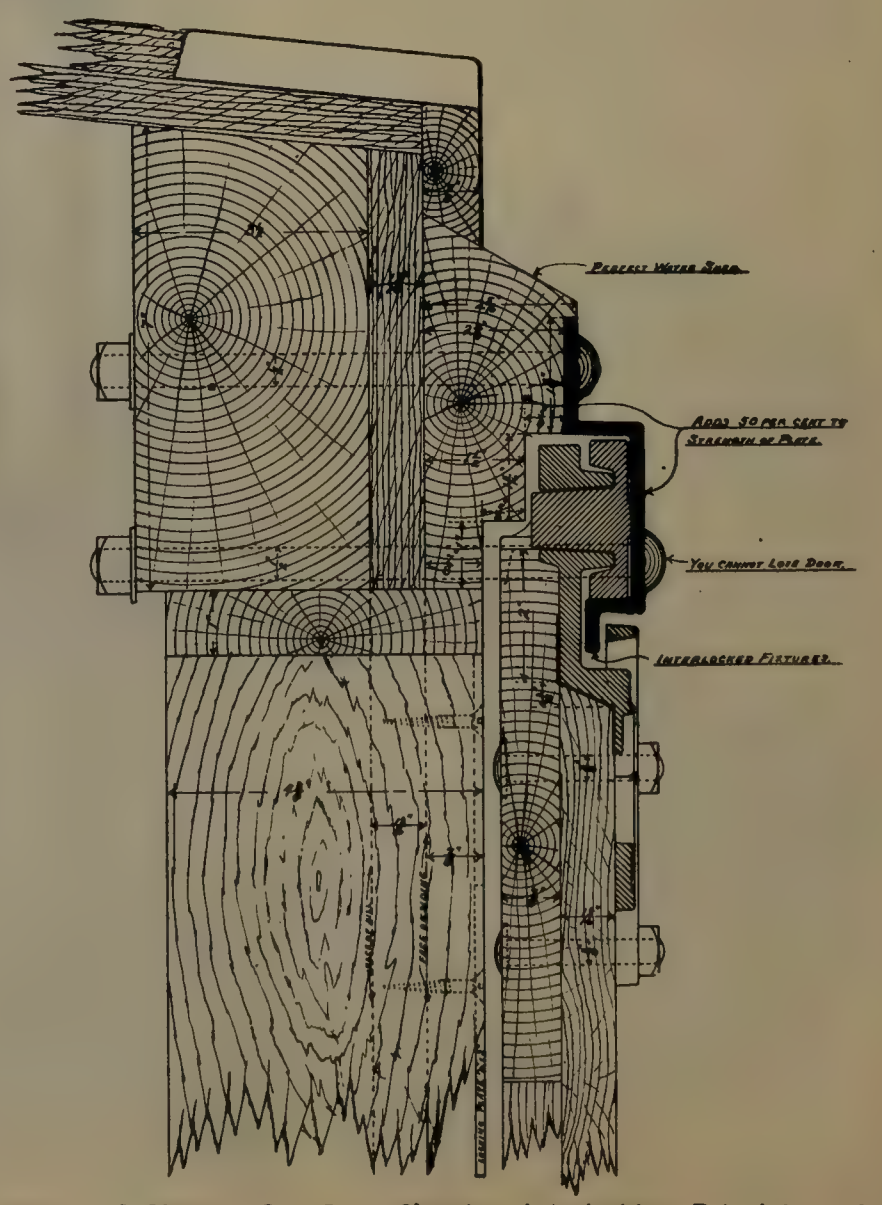
Aloxite wheels are shown grinding high speed steel tools, reamers, cutters and in general steel grinding. Aloxite is the ideal material for tool room work and for steel grinding. It is hard, sharp and with just the proper degree of toughness or temper to give it durability. The Aloxite wheel cuts clean and cool and holds its shape.

AN UNLOSABLE BOX CAR DOOR.

A new design for a box car door, as illustrated herewith, has recently been placed on the market by the Chicago Car Door Co., Monadnock Block, Chicago, Ill., and has received almost universal attention, several large orders already having been placed for it. As there are some features about it which are entirely new, it is worthy of careful consideration by railway men.

The track is a rolled steel section about five inches wide, and together with the block by which it is attached to the car, it more than doubles the strength of the plate at the doorway.

As the rolls operate on the inside face of the track they are thoroughly protected from snow and ice and are so arranged that either one of them will travel on the inside top of the track if the door is tilted, either in opening or closing, making it impossible to cramp the door, both rolls always being in contact with the track.



Section of Chicago Car Door Showing Interlocking Principle and Watershed.

This track also forms an indestructible hood and is a perfect water protection at the top of the door. It projects down on the outside face of the door for a distance unusually great. At the same time it is so interlocked with the hangers that, if the track is hanging loose on the side of the car, the door cannot be removed without taking out the bolt at the end of the track. This makes it impossible to lose the door off the car without wrecking the latter, a feature which is of interest to every railway official.

On the back edge of the door a spark strip is arranged to interlock with a plate on the face of the door post, similar to others in use, and forms a protection against either sparks or water entering the car at this point.

The bottom of the door is protected by burglar proof brackets, thousands of which have been in service for several years. These brackets form the guides for the bottom of the door and are so arranged that it is impossible to remove one from the car while the door is closed, even if the bolts, by which they are attached to the sill, are taken out, as the bracket has to be raised up a considerable distance before the lag screw can be removed.

The corner irons and wedges on the lower corners of the door are securely attached, and are intended to take the full thrust of the door against the end brackets, when the door is opened or closed, and at the same time hold it firmly against the face of the door posts. The general appearance of the poor is particularly substantial and attractive.

STANDARD CAR TRUCK EXHIBIT.

The Standard Car Truck Co., of Chicago, will exhibit on the Philadelphia & Reading tracks, Atlantic City, during the mechanical convention, a new type of flat car designed and thoroughly tested out in service on one of the large trunk lines.

The car is designed for 100,000 lbs. capacity and carries the load on two main drop steel girder sills of a special form. These sills are spaced apart with center lines directly over the center line of the truck side frames, which are also of the center lines of journals.

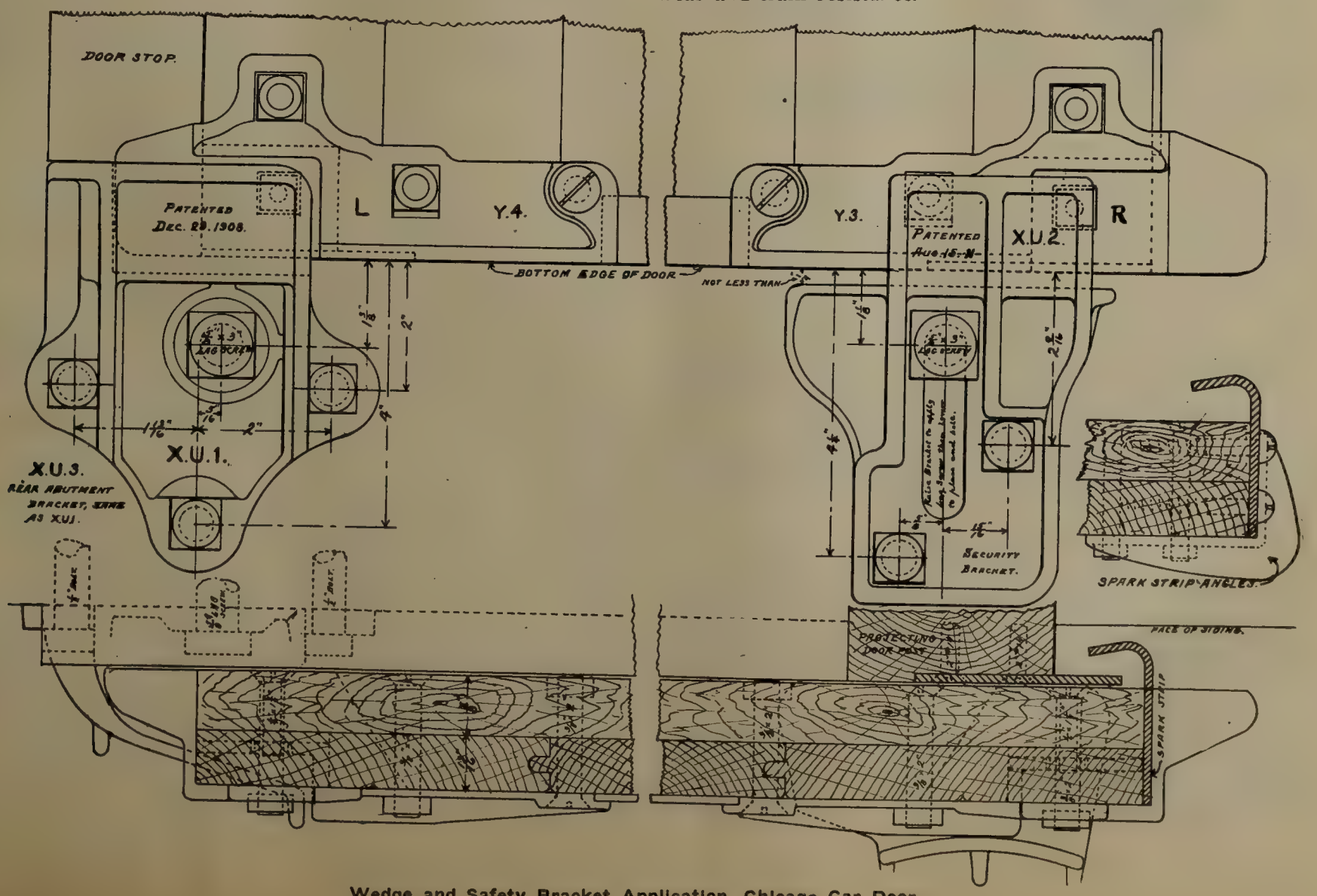
The radial and lateral travel of the truck is provided for in the Barber anti-friction truck devices, which are applied between the underside of the main body girders and the top of the truck-springs, and all of which rest and are supported centrally in the steel truck side frames. All details are carefully designed to meet railway requirements in case of repairs or renewal of parts.

The load instead of being carried on two center plates now in common practice is carried on the four steel bearings applied to each outer end of the truck bolsters. The present center plates and the load thereon, are entirely eliminated in the construction, the load being transferred directly in and over the truck frames which provide solid construction with free radial and lateral travel of the bolster, sufficient to lessen the blows and wear between wheel flange and rail.

The above construction, which removes the load from the center of the truck and body bolster on to the truck side frames direct, lessens their load fully 50 per cent, and increases the freedom for curving the truck fully 40 per cent, as compared with the present common standard center plates.

The truck side frames are of "I" beam drop girder shape preferably of cast steel. The truck springs are spaced in pairs, each side supported on a seat cast solid with the truck frames. The truck bolsters are rolled or cast steel "I" beam shaped with the web of the beam placed horizontal. The center pivot in place of center plate provides for and takes care of the buffing shocks. It is, of course, understood that there is no vertical load on this center pivot. The roller caps are of malleable iron and are secured to the under side of the bolster. The radial roller seats of cast steel secured on upper side of the bolster. The radial roller cap is also of steel. The three parts of the radial device are so arranged that they are interlocked into one member with freedom to move with the curving of the truck or car body.

The company has had several cars and trucks of a similar design in hard service for from two to four years, some of which have made 50,000 miles and still running with the original wheels, journal bearings and all other parts, and without expense for repairs. The car and truck are designed to give minimum weight and cost of maintenance, reduce wheel flange wear and train resistance.



Wedge and Safety Bracket Application, Chicago Car Door.

Recent Railway Mechanical Patents

CAR CONSTRUCTION.

1,026,945—James McCutcheon Coleman, Westmount, Quebec.

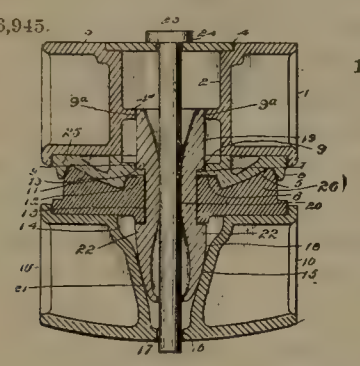
This is a center joint between the car body and the truck formed by the meeting center bearing parts of bolster members, locked together by expanding tie members engaging upper and under surfaces of the bolster members. The bolster is rigidly secured to the car body and has a center bearing portion centrally recessed and a pin-hole through the lower side thereof, the lower side being convexed and centrally recessed around the pin-hole, a truck, the bolster rigidly secured to truck has a center bearing portion with an upper side concaved in dish shape around a central upwardly projecting boss and a pin hole through boss and the lower side of the bolster. There are tie members having flanged heads and flanges toward the lower end thereof, said head flanges engaging said body bolster and said lower flanges extending under the lower surfaces in said truck bolster and a pin extending through pin holes between the tie members.

SMOKE-JACK FOR ENGINE-HOUSES.

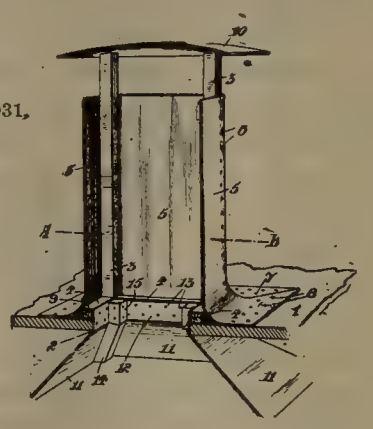
1,026,931—William Sclater, Westmount, Quebec, assignor of one-half to A. W. Stevenson, Montreal.

This is a smoke jack for engine houses. It has a chimney portion having a frame formed of a plurality of wooden posts sheathed

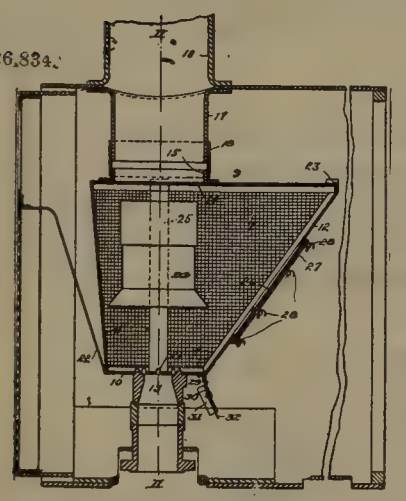
1,026,945.



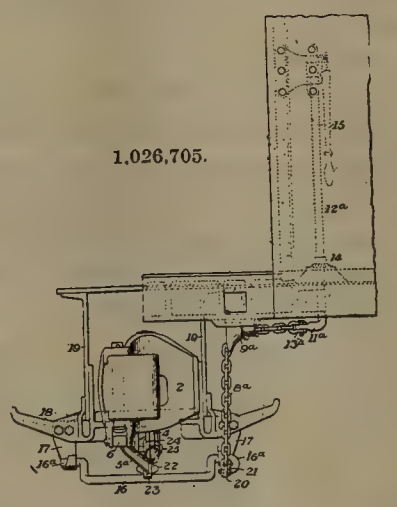
1,026,931.



1,026,834.



1,026,705.



in metal and rigidly secured to the roof of the engine house and projecting upwardly therefrom with metal walls rigidly fastened to the roof and extending part way up the posts, a cowl of metal rigidly secured to the top ends of said posts and a smoke-bell rigidly secured to the roof. It has a frame formed of a number of wooden lengths sheathed in metal and metal walls rigidly secured to said frame and extending upwardly into the chimney.

SPARK-ARRESTER.

1,026,834—Frank Slater, Escanaba, Mich.

This is a locomotive smoke box with an exhaust nozzle having upwardly projecting engaging means on its end, and an outlet pipe, of a removable screening box with an outlet at its upper end having a slip collar connection with the outlet pipe whereby the screening box may be moved upward, and having an inlet at its lower end in telescopic relation with the projecting means on the end of the exhaust nozzle. The upwardly projecting engaging means terminates adjacent to the bottom of the screening box so that the screening box and nozzle may be disengaged by a limited vertical movement of the box, and detachable means for holding the screening box against vertical movement.

TRUCK-FRAME.

1,026,744—Harry S. Hart, Chicago, Ill., assignor to Wolff Truck Frame Company, Chicago, Ill.

This is a car truck frame with a journal box having two parts separated by a substantial horizontal plane located approximately midway the top and bottom. All of the box above plane is integral with the side frame, and all of the box below said plane is detachable therefrom. It has an interlocking means formed integrally with the two parts of the journal box for supporting the lower part of the box.

TANK-CAR.

1,026,710—Charles A. Shoemaker, Chicago, Ill.

This is a tank car structure including a tank which may rise from its support. An underframe for supporting the tank permits a movement of the tank longitudinally, the tank and underframe structures having friction faces in frictional engagement. There is a means for forcing the tank to rise against the action of friction when the tank is moved longitudinally of the underframe.

HEADLIGHT-CURTAIN.

1,026,703—William L. Russell, Wellsboro, Pa.

This is a combination with a lamp housing, of a spring-actuated roller journaled adjacent the top of the housing. A secondary roller is journaled adjacent to the bottom of the housing. A curtain is wound about the spring-actuated roller and connected with the secondary roller. A pinion is connected with the secondary roller. A rack bar is supported for sliding movement and meshing into the pinion there is a fluid pressure cylinder into which the rack bar protrudes, and a piston head upon the rack bar, within the cylinder, the cylinder being located outside of the lamp housing.

UNCOUPLING MECHANISM FOR CAR-COUPLINGS.

1,026,705—Ernest H. Schmidt, Cleveland, assignor to The National Malleable Castings Co., Cleveland, O.

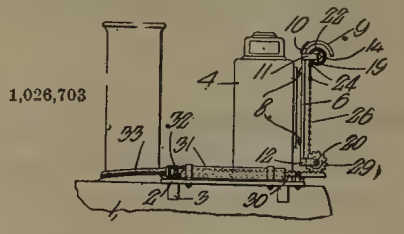
This is car coupler of the bottom-opening type, which has a vertically movable lifting piece, and a vertically movable lever for actuating said piece, a pivoted member connected to said lever, a ligting rod extending transversely underneath said member, a lifting chain connected to said rod, and a vertical rotary uncoupling rod to which the opposite end portion of the chain is connected.

GAS OR SMOKE WASHER.

1,026,666—Oliver M. Foster, Elkhart, Ind., assignor of one-fifth to S. K. Dickerson, one-fifth to D. R. MacBain, and one-fifth to DeWitt C. Moore, Cleveland, Ohio, and one-fifth to Charles E. Schaff, Chicago, Ill.

This is a device for use in roundhouses. It consists of a tank provided with a cleaning liquid, a substantially horizontal passage-way lying below the surface of the liquid in the tank and filled with liquid therefrom, means for forcing the gases of combustion through the liquid in the passage-way, and means for supplying steam under pressure to the liquid in the said passage-way.

1,026,703



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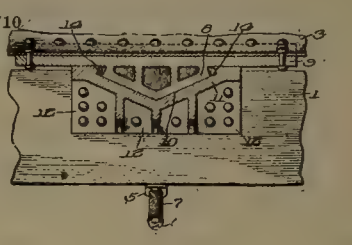

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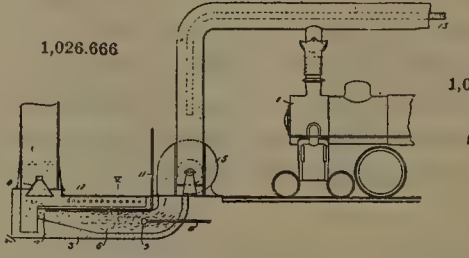

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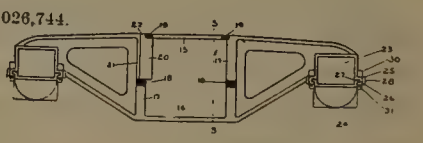

The Cambria Steel Co., Johnstown, Pa., has ordered one six-wheel switching locomotive from the American Locomotive Co. Dimensions of cylinders, 19 in. x 26 in.; diameter of driving wheels, 50 in.; total weight, 125,000 lbs.

The Chicago Junction has ordered 6 six-wheel switching locomotives from the American Locomotive Co. Dimensions of cylinders, 20 in. x 26 in.; diameter of driving wheels, 51 in.; total weight, 148,000 lbs.

The Chicago & Eastern Illinois has awarded a contract to the American Locomotive Co. for 25 mikado locomotives.

The Cuba R. R. has ordered 4 ten-wheel locomotives from the American Locomotive Co. Dimensions of cylinders, 18 in. x 24 in.; diameter of driving wheels, 52 in.; total weight, 127,000 lbs.

The Hocking Valley has ordered 5 mikado locomotives and 2 ten-wheel locomotives from the American Locomotive Co.

The Montpelier & Wells River is reported in the market for one passenger locomotive.

The St. Louis & San Francisco has ordered 40 consolidation locomotives from the American Locomotive Co.

The Terminal Ry. Association of St. Louis has ordered 15 locomotives from the American Locomotive Co.

The Cuba R. R. is said to be in the market for 100 box, 50 flat and 10 dump cars.

The Mineral Point Zinc Co. has ordered 41 tank cars from the German-American Car Co.

The Montpelier & Wells River is reported in the market for 3 coaches and 7 refrigerator cars.

The New York Central & Hudson River is said to be making inquiries for 2,000 steel underframe freight cars.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

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FIRE BOXES.

Those who witnessed the low-water boiler tests described on another page of this issue were treated to an exhibition it is seldom a railway official's lot to witness. Also it is seldom, if ever, that a railway equipment manufacturer displays so much confidence in a new device as to stage a comparative test so elaborate and expensive as this. The makers of the Jacobs-Shupert fire box have proven their enthusiasm and confidence to have been well warranted. The complete report of the efficiency tests conducted by Prof. Goss will not be available for some time. They will, however, be favorable to the new design and, what is more important, they will be absolutely dependable and authoritative.

The subjects of more ton-miles per pound of coal or greater evaporation per B. T. U. are one and are very interesting to the railway officer. The subject of safety from explosions and of relief from the constant menace of dropped crown sheets, is interesting also. Boilers are not designed to be burned; but boilers are burned every day in the year. The fact that the engineman, who through carelessness is responsible, often forfeits his life does not help matters any. A boiler which will not drop its crown sheet when overheated will not make the engineman more careless, for the evidence of low water is there, plain to the eye of the master mechanic. Such a boiler will decrease the number of casualties, engine failures and the other results of fire-box explosions, and this saving should be credited against the greater first cost of the new boiler if there is any. If the increase in efficiency of the new fire box is shown to be material, there should be comparatively easy sailing ahead for its makers. The Jacobs-Shupert United States Fire Box Co. is congratulated on the results of this elaborate, expensive and convincing series of tests.

A QUESTION OF POLICY.

A machine tool manufacturer of prestige recently received an order for a very large machine from the concern of which he purchased his castings. A part of the machine was a very heavy bed-plate casting which was slotted in its extension. This casting was, of course, made by the prospective purchaser of the completed machine. After the machine work was partially completed it was found that the large casting in question was imperfect in that there were thin places in the metal between the outer surface and the cored-out interior. The matter was explained to the maker of the casting and his answer was to the effect that inasmuch as the thin places were so located that the service of the machine would not be affected by any consequent breakage of the metal shell in the thin zone, he would accept the machine with the defective casting which he himself had made. After careful consideration the machine manufacturer decided not to go on with the work until a new casting was delivered, and to scrap the defective one. The foundryman purchaser than canceled the order, amounting to some $20,000, rather than replace the defective casting.

At first thought it would seem that a purchaser might properly be sold a defective article, provided he understands the case fully and consents thereto. The layman cannot, however, do other than admire the business prin-

ciple of the manufacturer in this case. The situation was a peculiar one, which does not arise frequently, and the explanation of the machine tool maker as to the position taken is interesting. He said: "Suppose the defect in the casting does not affect the service of the machine; it will probably become evident, after some machinist has dropped a heavy tool onto the thin place, that there was carelessness in the construction. That carelessness will be charged up to me by interested observers long after the conditions of the sale of the machine are forgotten. It will always be a disagreeable subject for contemplation and may easily result in a direct loss to my company in orders which might come from those who will see the defective casting."

The argument is unassailable, yet how many manufacturers would show this foresight under similar conditions?

FLANGE LUBRICATION.

The Master Mechanic's committee on flange lubrication has shown in its report that the good results from a proper lubrication of flanges are, to say the least, quite tangible. The report is not so clear in its advice as to principals of design of the device necessary to a proper application of lubricant to the flanges; also there is difference of opinion as to the lubricant itself.

Generally speaking, flange lubrication is desirable only on curves. This fact is used by some as an argument for some device which sprays oil on the flanges at the will of the engineman. This would seem to be the most economical system, but it is objectionable for the reason that it puts an additional burden, though slight, upon the mind of the engineman and therefore its action is not so satisfactory as it should be. In the case of the device using a solid lubricant such as a block of graphite, lubrication of the flanges is constant upon straight tracks as well as upon curves. The cost of the lubricant actually used is, however, very slight and the reliability of this system is a point in its favor. The graphite constantly applied by even spring pressure keeps the flange coated with this excellent lubricant and such as is removed by forcible contact with the rail head on curves is speedily replaced on straight track.

The use of a flange lubricator will probably soon be looked upon as a necessary part of the equipment of a locomotive. There are still, however, many points of difference as to the general system best adapted to fulfill its purpose, yet to be threshed out. Various methods of application will, of course, always exist.

A GOOD PRINCIPLE TO ENFORCE.

In the plant of the Morton Manufacturing Co., Muskegon Heights, Mich., as in that of every other machine tool manufacturer, there sometimes arises a question as to whether a slightly defective casting or part shall go into the construction of the machine for which it was designed. When the matter is brought to the attention of the higher authorities the foreman in charge of that particular job is invariably asked if he would care to purchase a machine into which the questionable part had gone, in preference to one perfectly built. Of course, the reply is, "Not if I know it." Then he is told to keep that application of the golden rule in mind and to give the machine under construction the complete benefit of any and all doubts.

The Hustlers

By Berton Braley.

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Dedicated to the Officers and Executive Committee of the Railway Supply Manufacturers' Association.

Back in the uttermost ages, further than history sees,
When most of our mortal races were living in caves and trees,
The gods sat down in council and soberly made a plan
For getting that ultimate product—the regular modern man;
They peered through the veil of the future with many a god-like eye
Until they got the vision of the Twentieth Century Guy!

Then they put their heads together, and all of them said, said they,
"We gotta make up a sample and do it without delay;"
So they fashioned a modern mortal from common or garden clay.

They gave him the tongue of a lawyer, the smile of a college boy,
The nerve of a life insurance man and a heart chuck full of joy,
The wit and charm of the Irish, the bulldog will of the Dutch,
They added a lot of good fellowship—but nary a bit too much;
They made him the glass of fashion, the swellest thing in the clan,
And they made him a vigorous, live, alert and cracker-jack Business Man.

And when the sample was finished, he started in to perform,
He greeted the gods assembled with a handclasp firm and warm,
Then he sold them patent couplers—though they had no cars to coup—
He sold them engines for laying rails and engines to pull them up,
And they had to take him apart at last and turn him back to clay
Because he was much too up-to-date for that primordial day;
But his present reincarnation—I'm willing to put you wise—
Is still in the same old business of selling railway supplies.

So here's to the Railway Supply men and the stuff they make and sell;

They furnish the things that a road must have and that
do their duty well,
For a railroad going without supplies would last like
snow in hell!

"We have with us to-night" some "Big ones" of the
Railway Supply Men's crew,
S. G. Allen, their president, who sits in the Amen pew,
Who works for the house of Franklin and feels decidedly
blue
When his guests tone down the beautiful splurge he
wanted to treat them to.

Hageman (B. E.),
U. S. Metal Co.,
Is the new V. P.
Of Supply Men. So
Provided all of those headlights are stamped with the
name of "Pyle."
Bronzed with the southern sunshine, fond of the south-
ern soil,
George L. Morton smilingly spreads the balm of Galena
Oil,
Where Sherman's men once trampled meadow and lane
and lea,
He makes a peaceful conquest from Atlanta to the sea!

The purr of a racing auto, the whirr of the spinning tire,
These are J. R. Blakeslee's joy—the goal of his heart's
desire,
He loves the sight of an Ajax tool—especially one that's
sold—
But the lurch and jar of a motor car are more to him
than gold!

Supplymen's Executive Committee, 1911-1912. Left to Right, Standing: Messrs. Johnson, Storrs, Morton, Brown, Blakeslee, Riley, Adreon, Ashton, and Lanahan. Seated: Messrs. Walker, Allen, Stafford, Conway and Lord.

He comes next to Sam
Allen—all salaam!
What the secretary has to do
Is to do it all.
Work like his is never through
(J. D. Conway knows that's true
Winter, Summer, Fall)
He must see the whole thing through
Which is nothing small!

Not till electric headlights flash on each railroad mile
Will J. Will Johnson be satisfied, and then he may rest
awhile
Blithe L. C. Brown is strong for togs
And things in latest fashion,
Though selling wary railway ducks
A lot of good United trucks
Is quite his latest passion.

O. F. Ostby says a headlight
Ought to burn acetylene.
Oil, he thinks, is but a dead light.
For a white, or green or red light
He would have a radiance keen,
One to see by—and be seen.
Moral—"burn acetylene."

Next we come to Rosser—W. W. Rosser—
Selling journal boxes is his line;
Laugh that's glad and mellow, he's the kind of fellow
Makes you feel that life is something fine!

Westinghouse, they tell us,
Thinks a lot of Nellis,
Likes the way he knows his goods and sells 'em to the trade
(That's the way a salesman earns the salary he's paid).

Let us now consider (slightly altering the strain)
Brother E. H. Walker—who sells couplers for a train;
Also S. M. Dolan, from St. Louis-by-the-Creek,
Selling cars and such-like every minute of the week;
Buckeye Castings Company presents to public sight
J. C. Whitridge—quiet chap—who doesn't think it right
To land upon committees when he isn't ready—quite.
Here's Lanahan, of Pittsburg—his Christian name is Frank—
And also from that city where the rollers roll and clank
And the roaring furnace bellows in a heat that makes you reel,
One George N. Riley haileth with his many tubes of steel.

And there is Stafford, the bolt man, who's finished his little term
As President of Supply Men—*he* has no third term germ!
He'll sit in the rear and chortle, watching Sam Allen squirm!
While E. L. Adreon, seller of brakes, weareth a happy grin
Now that he's done wth committee work
(Hard and grinding and gritty work
Making the form grow thin!)

Ashton (Albert), of Boston town, maker of valves of note,
Is happily free of the drudgery which committee service is bound to be,
And a joyous and cheerful man is he with a chuckle deep down his throat,
While Charles P. Storrs—of Micafame—(I reckon he sells his own)
Is done with the fret and toil and sweat that committee members have known.
The other fellows can labor now—HIS time of trouble is flown!

Here endeth the tale of supply men, the workers who ran the show,
Who saw that the fun and the work were done in the way that they ought to go,
For when the jesting is finished, and we read the truth in their eyes,
They're a mighty rare bunch of good old scouts—the fellows who sell supplies!

You never can lose the Supply Men,
You find 'em wherever you go;
They are not backward or shy men,
They never were known as slow.
You may climb to the heavens so high, men,
Or drop to the regions below,
But you're certain to meet the Supply Men
Wherever you happen to go!

Low-Water Tests on Locomotive Boilers

As noted in the June issue of the *Railway Master Mechanic*, Prof. W. F. M. Goss has carried on a series of tests at Coateville, Pa., for the purpose of obtaining comparative data on the Jacobs-Shupert fire box. These tests have been the most thorough of the kind heretofore made on locomotive boilers, and when the complete report is made several months hence the information should be found most valuable.

On June 20, 1912, all other tests having been completed and the boilers (one equipped with a radial stay fire box and the other with the Jacobs-Shupert) having been moved out and set upon concrete foundations on a cinder dump of the Lukens Iron & Steel Co., some distance from the town, a comparative low-water test was commenced. The boilers were treated exactly alike in setting and equipment and the safety valves, of which there were three on each boiler, were set to blow at approximately 225 lbs. The spectators were provided for in a grandstand on a side hill overlooking the boilers. The official observers were located in a protecting "bomb-proof" about 200 feet from the boilers. Arrangements were made whereby the spectators were each closely in touch with the conditions of the boilers during the tests.

Test of Jacobs-Shupert Boiler.

The boiler equipped with the Jacobs-Shupert fire box was tested first. The boiler being under steam at 225 lbs., with a heavy fire and with the water at about 6 inches above the crown sheet, the feed water was shut off and the level was lowered steadily until it went below the lowest gage, which was 25 inches below the crown sheet. When the water level was lowered to 20 inches below the crown sheet it became impossible longer to keep the maximum steam pressure. As the test proceeded the pressure constantly diminished until at 50 lbs. the test was declared ended. The test lasted 55

Bomb Proof Observation. (Note Telescope.)

Interior of Jacobs-Shupert Firebox After Low Water Test.

minutes, most of which period the water was below the crown sheet. No material damage occurred other than the overheating of the sections composing the inner fire box. There was no fracture and no serious leak.

Test of Radial Stay Boiler.

The test on the radial stay boiler was started and carried on under precisely similar conditions. At the start all three safety valves were blowing at 227 lbs. pressure. The water stood 5 inches above the crown sheet when the feed was shut off. In about 10 minutes the crown sheet was bare. With the water at 6 inches below the crown sheet, there were signs of distress at the staybolts in the outer sheet.

Water Gauges for Long Distance Reading, on Back of Boiler.

Interior of Radial Stay Firebox After Low Water Test.

Explosion of Boiler Equipment with Radial Stay Firebox.

Grand Stand and Invited Witnesses to Low Water Tests—Coatesville, Pa., June 20, 1911.

Streams of steam were seen issuing from a number of them. Then the girth seam between the throat sheet and the shell developed a leak, and as the water level fell the staybolt leakages came down with it.

At a water level 14½ inches below the crown sheet there was a puff of black smoke from the right-hand side of the foundation. This was followed by a blast of black smoke from the left, a roar, a cloud of smoke and flying debris. The expected explosion had occurred. Inspection showed the boiler had been lifted and moved a considerable distance from its foundation. The crown sheet had come down in a sag for a distance of about 18 inches, but had not split or cracked. The staybolts had merely either pulled out of the sheet or had been broken off at the head. There were 72 radial hammer-headed staybolts pulled; 81 button-headed stays and 21 T-bar bolts. The main damage was on the right side, beginning at about the second row of T-bars and running back 14 rows. Apparently one of the hammered head stays was the first to yield; this allowed the sheet to drop and the heads of the other bolts were simply jerked off.

General.

The tests were conducted with an evaporative rate of about 12 lbs. of water per square foot of heating surface per hour. Other conditions were made as fair as possible to either boiler. The tests were made possible by the Lukens Iron & Steel Co., of Coatesville, Pa., which concern financed the Jacobs-Shupert United States Firebox Co

HEAVY PACIFIC TYPE LOCOMOTIVE, LOUISVILLE & NASHVILLE R. R.

The Louisville & Nashville R. R. has for several years very successfully built its own locomotives at its South Louisville (Ky.) repair shops. The design as well as the construction of locomotives is the result of home effort. This type is known on the L. & N. as "Class K3" and five of the order have been completed, leaving eight under construction. To date thirty-eight locomotives have been built since July 1, 1911.

The accompanying photograph shows that these latest engines are built to conform with the most modern of accepted practice. Schmidt superheaters and brick arches are included in the boilers. The half sloping mud ring meets an unusually deep throat sheet and broken grate to follow the lines of the mud ring, was necessitated. It will be noted that the boiler feed water is injected at the top near the front end of the boiler. This is in accordance with an idea which has been supported the last few years by several mechanical officials. The water is projected against baffle plates beneath the check valves which are of special construction. The water is thus sprayed over considerable area and heated as it falls. A local area of low temperature is thus to a considerable extent avoided.

A compact installation of the Walschaert valve gear with large piston valves and outside steam pipes lends to the interest of the engine as a whole. The general appearance has further been taken carefully into consideration by a symmetrical arrangement of domes and boiler accessories.

Heavy Pacific Locomotive, Built by Louisville & Nashville R. R.

A table of principal dimensions follows:

Type	4-6-2 Pacific
Service	Passenger
Gauge	4 ft. 8½ ins.
Cylinders, Bushed	21½ ins. x 28 ins.
Valves, Inside Admission, 6¾ in. travel, 1⅛ in. lap, ¼ in. lead, ⅛ in. exhaust clearance, 12 in. diameter, Piston Type.	
Tractive Power	30,205
Factor of Adhesion	4.33
Boiler, Type	Straight Top
Minimum Diameter	71 ins.
Working Pressure	190 lbs.
Fire Box, Size	72¼ ins. x 90⅛ ins.
Water Space	3½ ins. sides and back, 4 in. front
Grate Area	45 sq. ft.
Fuel	Soft Coal
Fire Arch Brick on 3 in. Tubes.	
Tubes, Number	21 and 154
Diameter	5½ ins. and 2¼ ins.
Length	18 ft. 6 ins.
Heatin Surface, Fire Box	210 sq. ft.
Tubes, 2¼ ins	1,648 sq. ft.
Flues, 5½ ins	567 sq. ft.
Arch Tubes	19.7 sq. ft.
Superheater	356 sq. ft.
Total	2,801 sq. ft.
Ratio of H. S. to Grate Area	60
Ratio of H. S. to Cylinder Volume	229
Driving Wheels, Diameter	69 ins.
Journals	9 in. and 9½ in. x 12 in.
Engine Truck Wheels, Diameter	33 ins.
Journals	5½ in. x 11 in.
Trailer Wheels, Diameter	49 ins.
Journals	7 ins. x 14 ins.
Walschaert Valve Gear.	
Schmidt Superheater.	
Bunn Safety Railway Headlight.	
Weight, on Driving Wheels	131,000 lbs.
Total Engine	211,500 lbs.
Total, Engine and Tender	354,900 lbs.
Wheel Base, Driving	12 ft. 0 ins.
Total Engine	30 ft. 7 ins.
Total, Engine and Tender	62 ft. 9½ ins.
Tender, Type	8 Wheel Type with Cast Steel Frame
Tender Wheels, Diameter	33 ins.
Capacity, Water	7,000 Gallons
Journals	5½ in. x 10 ins.
Capacity, Coal	15 Tons

Chapel Car of Interesting Design.

Interior of Chapel Car.

CHAPEL CAR.

The Barney & Smith Car Co., Dayton O., has recently completed a very handsome new chapel car for The Catholic Church Extension Society of the United States.

An unusual and prominent feature of this car is the idea of similarity conveyed by its interior, through the manner in which the various emblems and symbols of the church have been incorporated in the furnishings, and its scheme of architecture and general appearance, to the interior of some of the large Catholic churches and cathedrals, more particularly the older English cathedrals, and, while of course on a less extensive scale, it is as complete in essential equipment as any of the large church edifices.

The interior finish is of carefully selected and rich looking St. Jago mahogany, the ceilings being finished in a handsome shade of dark green, with a neat design of decoration. The interior trimmings and hardware are statuary bronze, the lighting fixtures being of a very attractive pattern. The interior of the car is given a further elegant effect by the artistic patterns of art glass in the inside upper windows and the deck sash.

In designing the interior of the chapel, the builders have followed the old Gothic type of architecture, and this has found fitting expression in the details of the finish, altar, furniture, glass, decorations, etc., and has embodied in an appropriate and effective manner the emblems and symbols of the Catholic Church, giving the whole a most dignified and imposing as well as a very artistic appearance and impressing the observer with its ecclesiastical character.

The altar and stanctuary have been placed on a platform elevated 6 inches above the floor, and are fully equipped with the essential church furnishings, ornaments, etc. Trap doors are located in the platform, and the space underneath utilized for storing literature which the car will carry.

Between the sanctuary and the auditorium is located a communion railing, above and in conjunction with which, after the fashion followed in English cathedrals, has been built a screen of scroll work nature, on which is mounted the rood or cross, this whole structure forming a sort of screen in front of the altar, and also affords a means of attaching a curtain so that the space between the communion railing and the sanctuary can be curtained off when the car is stationary and engaged in its missionary work.

The altar and sanctuary have been placed on a platform which is decorated with handsome carving, and above this is placed the movable crucifix. There are two small steps on each side of the tabernacle to receive candlesticks, urns or other ornaments. The altar is equipped with drawers below for vestments and altar supplies.

At one side of the altar, on the raised platform of the sanctuary, is located the confessional, the penitent's compartment having the customary Prie Dieu, or kneeling bench with arm rest.

A kneeling step extending the full width of the car is placed in front of the communion railing, and shorter steps for the same purpose are placed in front of each pew. These are arranged so that they may be raised up under the pews when not in use.

On the piers between the double windows in the chapel, let into the side finish, are placed photographs of oil paintings—one on each pier—illustrating the Stations of the Cross.

An organ, designed and built especially for this car, is located near the entrance to the chapel at observation end of car, together with a combination organ bench and cabinet for music and books.

The car has sufficient berth space and other accommodations for several people. The dining room and study is supplied with a bookcase and desk, extension table, and seven arm chairs upholstered in plush, the floor of this compartment being covered with Wilton carpet.

The car further includes a superintendent's room, shower bath, a fully equipped kitchen, and ample toilet facilities. It is also provided with abundant locker space, in addition to which large storage boxes are located under the car for carrying provisions and supplies.

The exterior of the car is painted standard Pullman color, the name of the society appearing in gold leaf on the letterboard, with the name of the car, "St. Peter," and the society's coat of arms in colors located on the center of the sides of the car.

This car is 74 ft. 10½ in. long over end sills, and is of very substantial construction, having a built-up structural steel underframe, steel superstructure framing and steel exterior, the exterior sheathing consisting of ⅛ in. steel plates, the framing being Barney & Smith standard for steel car with wood interior finish, and includes the Barney & Smith anti-telescoping device. The roof is of standard shape and is covered with copper.

The car is well insulated throughout to insure the greatest comfort in the varying temperatures which it will experience. It is vestibuled on one end, and has an observation platform enclosed with railing and gates at opposite end; it is mounted on Barney & Smith standard composite six-wheel trucks, is equipped with Westinghouse air brakes, acetylene lighting system with generator, direct steam heat with B. & S. steel fireproof heater, friction draft rigging, Barney & Smith steel trap doors with automatic lifting device and the Barney & Smith standard air pressure water system with an air pump for auxiliary use when the car is stationary for any considerable time.

Report of 46th Annual Convention, Master Car Builders' Association

The 46th annual meeting of the Master Car Builders' Assn. was held in the Greek Temple on the Million Dollar Pier, Atlantic City, N. J. Mr. A. Stewart of the Southern Railway called the meeting to order at 9:30 o'clock Wednesday, June 12, 1912. A prayer was offered by the Rev. Mr. Cadwell which was followed by an address by Mayor Bacharach. The mayor's speech was responded to by Mr. J. J. Hennessey of the St. Paul. In his reply Mr. Hennessey spoke of the regret which he felt in missing the face of former Mayor Stoy, who died during the past year. The address of President Stewart followed, which is given herewith. Following Mr. Stewart's address there was an intermission of five minutes to allow all those who desired to retire from the meeting.

Address of President Stewart.

We are assembled this morning to conduct the business assigned for consideration at this, our forty-sixth annual convention of the M. C. B. Association, and it gives me great pleasure to welcome you.

The meetings of the Association, which have now been held for forty-six consecutive years, have contributed more than the work of any other organization toward making it possible for the vast railroad interests in this country to carry on their interchange of business. We are meeting again this year, with the approval of our respective companies, to further perfect our rules, and, if possible, to revise them in a manner that will still further reduce our cost of maintenance and clarify matters that have not been understood alike by all of our members; also to devise the best possible manner of complying with new legislation affecting the construction, maintenance and handling of equipment in interchange.

Much earnest work has been done by the committees on the various subjects up for consideration by this convention but on account of the range of subjects listed for consideration, upon which reports are to be presented and discussed, it is deemed neither practicable nor desirable in this address to discuss in detail or to analyze the general work of the committee as represented by their reports.

On account of the personnel of the various committees and the earnest efforts that have been expended in the preparation of their reports, the amount of work that has been accomplished is not only creditable, but the Association is to be congratulated upon the excellence and quality of the work as reflected by these reports.

A very important matter that has not been assigned to any committee, and I believe it is of such vital importance that action should be taken, relates to the interchange of equipment as affected by the recent safety appliance acts. We have had nearly a year's experience working under the new order of things and questions have been raised that can only be answered with the approval of this Association, and I urge the necessity for action. We are required to change the safety appliances to standard on both system and foreign cars going through the shops for general repairs, and we should have a rule for charging the car owner with a portion of this expense. It is my understanding that we are now subject to a penalty for handling cars marked "U. S. Safety Appliances" if the cars so marked are not in accordance with the law. To inspect all cars received with safety appliance defects, including location, is obviously out of the question and we should have a rule that will relieve the receiving line for penalty defects and material, location or manner of application, when cars have been stencilled as complying with the law.

Cars that have been fitted with the special 12¼-in. coupler to give the required end clearance should be so stencilled for protection to the owners and for the information of the inspectors.

We should consider a rule for a fair basis of interchange where it affects the removal or turning of steel wheels under freight equipment, and a proper charge for wooden cars which have been reinforced by continuous metal draft sills.

The question of changing the present M. C. B. Specifications for air brake hose has been brought to my attention, and a committee should be appointed to take up this matter and report what changes are necessary.

All of the members are earnestly requested to bring up the matters affecting interchange in which they are interested in the hope that we may be able to promulgate rules so clear that they will be understood and accepted by all without the necessity of such frequent recourse to the Arbitration Committee.

It should be our earnest endeavor to promote to the fullest extent the harmonious relations that have hitherto existed between the Interstate Commerce Commission and its representatives and this Association, and in this connection I want to call your attention to the fact that the last Convention took notice of the work of the conference committee, composed of members of this Association, that had to do with adjustment of the relation of the railroads to the government with regard to safety appliances. That committee has been continued as a sub-committee of the special committee on the Relations of Railway Operation to Legislation, and during the last year represented the railroads in a conference with the Post Office Department on standardization of postal car construction and equipment. This work has not been entirely completed, although specifications have been agreed upon, approved and issued by the Post Office Department, covering construction of steel and steel underframe full postal cars and

the equipment for all classes of mail cars. The work of this committee has illustrated the value of co-operation as between the railroads and the different branches of the Federal Government in formation of regulating legislation, and I want to say that a great credit is due to the committee and especially to the chairman of that committee for the very able manner in which the subject has been cared for.

The hours to be devoted to our daily sessions are so arranged that time may be conveniently devoted to the sights and delights of this great seaside resort, but we should not be unmindful of the fact that we are here principally to attend to business, and, therefore, I respectfully urge that each attendant, aside from his prompt and regular attendance on the daily session, should take full advantage of the special opportunity to inspect and study the latest improvements in equipment and appliances as exemplified in the special exhibit of the Railway Supply Manufacturers' Association. Never have the supply companies appeared before us with such an extensive exhibit, this year's exhibit even surpassing the high standard of excellence of former years.

At the close of the forty-six years' existence of our Association, it is gratifying to note not only the general progress that has been made by reason of the solution of the problems that have been presented, but also the general influence for good accomplished by the Association in the practical railroad world.

To the members of the railroad press represented here I desire, in behalf of the Association, to express our appreciation of their enterprise and assistance in the past as well as at this meeting.

I regret that during the past year death has claimed the following members: Julius Krause, W. H. Lungren, F. H. Scheffer, E. Fisher, G. H. Davis, R. N. Durborow, J. F. Mann, G. J. DeVilbiss, G. W. Dixon.

As the close of my service as president of this Association is near at hand, I desire to thank you for the honor you have conferred upon me in electing me to the position that I am so soon to relinquish, and I desire to further acknowledge my appreciation for the hearty co-operation I have received on all sides in my efforts to satisfactorily administer the affairs of the Association.

REPORT OF THE SECRETARY AND TREASURER.

Mr. Taylor in his report stated that the active membership in June, 1911, was 422 and the representative membership, 331. In June, 1912, there were 443 active members, 397 representative members, 14 associate members and 20 life members, making the total membership at present, 874. During the year, 38 railways and private car lines had indicated their desire to come under the rules of interchange governing freight cars, and 7 had indicated their acceptance of the interchange rules governing passenger equipment. Cars represented in the association in June, 1912, are 2,959,397, an increase of 494,867. The treasury in June, 1912, showed a balance of $627.91.

This report was referred to an auditing committee composed of T. H. Goodnow, E. W. Pratt and F. F. Gaines. Dues for the coming year are to be $4.00 as before.

The secretary read a letter from Mr. C. E. Fuller stating that he was unable to attend, as his wife was sick at a hospital in Chicago, and he deemed his first duty to be to her. Mr. Pratt moved that the letter be accepted and a vote of sympathy be extended to Mr. Fuller.

REVISION OF CONSTITUTION.

Previous to the adoption of the present Constitution, June, 1909, a nominating committee presented a verbal report to the convention at the first day's session, and the election called at the third day's session was viva voce. It was felt by some of the members that this method did not offer the best opportunity for the membership to express their preference as to officers of the association, and, therefore, when the Constitution was changed provision was made for the so-called secret ballot. It has developed in the election since the adoption of the Constitution that this method is not entirely satisfactory, requiring considerable time.

Your committee has given consideration to the methods employed by the various technical associations for nominating and electing officers, and submit herewith the changes in the Constitution which it would suggest, as well as sample forms of ballots to be used.

In the proposed method each member has an opportunity to vote for the membership of the Nominating Committee and at the same time has opportunity to vote for any other member than those named by the Nominating Committee if he may desire to do so.

Your committee would suggest, in order that this method, if approved, may be used at the Convention of 1913, that the subject be referred to letter ballot in January, 1913. It is impossible, under the present Constitution, to change the method before the date mentioned.

The changes in the Constitution, submitted by the committee, are as follows:

Article 7, Committee on Nominations, section 1 to be changed to read as follows:

"Section 1. It shall be the duty of the Committee on Nominations to offer to the convention the name of one member as a candidate for each of the following offices: President, First Vice-President, Second Vice-President, Third Vice-President and Treasurer, and the names of three members as candidates for Executive members. Each person so named shall be either an active or representative member of the Association."

Article 9 to be added to by a second section as follows:

"Section 2. Printed ballots for use in the election of officers, Executive members, the Committee on Nominations, and for Associate and Life Membership, to be of the form appended hereto."

The ballot for president, for first vice-president, for second vice-president, for third vice-president, for treasurer and the one for executive members, contain just the number of names to be voted for, with one blank space. The following instructions accompany this ballot:

"To vote in favor of all the names on this ballot leave it as it is unmarked. To vote against a nominee draw a line through his name. If you wish to vote for another eligible person write his name under the one marked out. The names printed are those of the candidates proposed by the nominating committee."

The ballot for the Committee on Nominations is composed of ten names with instructions to vote for five. A blank space is also left for any additional name. The following instructions accompany this ballot:

"To vote against a nominee draw a line through his name. If you wish to vote for another eligible person write his name under the one marked out. The names printed are those of the candidates proposed by the executive committee."

In the case of the ballot for life and associate membership, the instructions are to leave all names unmarked that are to be voted for and draw a line through the name of the one to be voted against.

(Signed) D. F. Crawford,
C. A. Seley,
A. Kearney.

Discussion.

H. H. Vaughan: Some members may wish to propose candidates aside from those recommended by the committee, and there should be some way by which any man's name may be inserted on the request of a certain number of members.

F. F. Gaines: I wish to make it clear that members are to have the privilege of voting in the matter of standards, according to the number of cars.

C. A. Seley: The names are printed on the form as reported by the committee on nominations, and below there is a blank in which the name of any member may be written.

F. W. Brazier: There is a great deal of red tape in the election of our officers, and in looking over the list of our past presidents, I feel well satisfied with the old way of electing officers. I wish to call attention to the fact that there is not one car man on the list of members proposed for election on the executive committee.

H. H. Vaughan: The American Society of Mechanical Engineers print the nominees in the regular form, but if any group of members desire to put up some other candidate, they may do so and the name of this candidate is entered on the regular ballot. The nomination of a candidate in this way has to be signed by a certain number of members.

C. A. Schroyer: This is a question of changing the constitution which cannot be done at present anyhow.

H. H. Vaughan: I will make an amendment that where say twenty members desire to put a name on the ballot, that the secretary shall have that name printed.

Mr. Seley accepted Mr. Vaughan's amendment and the motion was carried.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE.

After due consideration of present standards and recommended practice of the Association, together with replies from members to the circular of inquiry, and in connection with which we wish to say that very few of same were received; also requests involving standards presented by the secretary, your committee desires to report as follows:

STANDARDS.

Journal Boxes and Details.

Pages 523, Sheets M. C. B. 7 and 9.

2. A member suggests that the wedge for the 5 by 9 inch be changed in design to provide for increased end-bearing surface against stop lugs.

The committee concurs in this recommendation.

Journal Boxes for Passenger Cars.

Page 525, 5 by 9 inch Sheet M. C. B. 8-A; 4¼ by 8 inch Sheet M. C. B. 13.

3. Your committee received the following communication from McCord & Co.:

"On looking over the recent designs of passenger pedestal journal boxes we were very much impressed with the lack of consistency in the areas of the equalizer seats.

"A 3¾ by 7 inch journal has an area of 26¼ inches, the equalizer seat is 3⅝ by 6½ inches, giving it an area of 23½ square inches.

"The area of the 4¼ by 8 inch journal is 34 square inches. The equalizer seat is 3½ by 6¼ inches, giving 21⅞ square inches of bearing surface.

"The area of the 5½ by 10 inch journal is 56 inches, and the equalizer seat as designed at present is 3½ by 6 inch, giving it also 21 square inches of equalizer bearing surface.

"The 3¾ by 7 inch box is not illustrated in your Proceedings, so I do not know where these dimensions have been obtained, but the 4¼ by 8 inch and the 5 by 9 inch are M. C. B. Standard.

"The 5½ by 10 inch has not been passed upon by the Association, but the railroads seem to be inclining toward 3½ by 6 inch for the equalizer seat. It seems to be only reasonable that the equalizer seat area should be in direct proportion to the journal area.

"In following up the service given by these boxes it is evident that the equalizer seat area on the 5 by 9 inch box is not sufficient. The boxes seem to wear out in the equalizer seat before they do in the pedestal channels, and the object should be to have them both wear out at the same time."

The committee refers this to the Committee on Car Trucks.

Passenger Car Journal Box and Contained Parts.

Page 525, Sheet M. C. B. 8-A.

4. A member calls attention to the passenger journal box, the mouth of same not conforming with that of the 5 by 9 inch freight box.

The result of letter ballot shows that it was the intention of the Association to have the mouth of the 5 by 9 inch passenger journal box conform to the freight box.

The committee agrees with this and instructs the Secretary to make the necessary correction.

5½ by 10 Inch Journal Box and Details.

Page 524, Sheets M. C. B. 10 and 12.

5. A member suggests that the wedge for the 5½ by 10 inch be changed in design to that shown in sketch accompanying, to provide for increased end-bearing surface against stop lugs.

The committee concurs in this recommendation.

5½ by 10 Inch Journal Box and Contained Parts.

Page 524, Sheet M. C. B. 10.

6. A member calls attention to the journal bearing and wedge gauges as per Sheet 12, which should be Sheet 14.

Your committee agrees and instructs the secretary to make the necessary correction.

Dust Guards.

Page 533, M. C. B. Sheet 15.

8. Your committee received the following communication from McCord & Co.:

"We beg to call your attention to some inconsistencies in freight and passenger journal-box designs, so far as the M. C. B. standard dust guards and the dust-guard slots and the holes in the dust-guard walls of the M. C. B. boxes are concerned. In this connection we are enclosing herewith our blue-print No. 2637, being a diagram showing the clearances of the dust-guard seat on the axle and the box and the dust guard on the box in various positions.

"You will note that when the dust-guard seat of the axle moves the distance 'E' to strike the dust-guard wall of the box it will crush the dust guard unless the dimension 'F' is greater than 'E.'

"Referring to the dimensions 'E' and 'F,' you will note they are the same on the 3¾ by 7 inch and the 4¼ by 8 inch boxes, but that there is an addition of ¼ inch on the 5 by 9 inch boxes, so that the dust guard has crushed ¼ inch every time the two cars are brought together with sufficient shock to have the dust-guard seat on the axle strike the dust-guard wall of the box.

"You will notice that the dimension 'E' is 11/16 inch and 'F' is ⅛ inch on the 5½ by 10 inch, so that the dust guard of this box is crushed 9/16 inch when the axle hits the wall. The dust guard is also crushed out 9/16 inch more when the axle is moved to the other side, making the hole in the dust guard 1⅛ inch larger than the axle, with which it is supposed to make some kind of a joint.

"In each case also 'H' and 'K' ought to be equal, or 'K' ought to be greater than 'H' to permit of a reasonable amount of dirt accumulating in the bottom of the dust-guard slot and not cause binding, so that when jacking up a box to remove brass the dust-guard seat of the axle would strike the dust-guard wall again before the dust-guard bottoms in the box.

"You will note that in the 3¾ by 7 inch 'H' is ⅜ inch and 'K' is ⅝ inch, allowing the dust guard to have still ¼ inch clearance when the box is raised as high as it can be, but on the 4¼ by 8 inch you will note that 'H' is ½ inch, whereas 'K' is only 7/16 inch. That would mean that the dust guard is crushed at least 1/16 inch every time the box is jacked up to its maximum and will be crushed more than that whenever there is any accumulation of dirt in the bottom of the slot. This also causes trouble in an attempt to hold the wheel down when jacking up a box to remove the brass and must cause unnecessary delay to train when an attempt is made to change the brasses en route.

"On the 5 by 9 inch 'H' is 11/16 inch and 'K' is only ½ inch.

"On the 5½ by 10 inch the same condition.

"In the malleable-iron boxes, due to the reduced section, 'K' is ⅛ inch greater on the 3¾ by 7 inch and 3/16 inch greater on the 4¼ by 8 inch, 5 by 9 inch and 5½ by 10 inch boxes. On the 5 by 9 inch and 5½ by 10 inch boxes this gives you the same dimension for 'K' as for 'H.'

"In designing the dust guard in the back of the box, including the opening in the dust-guard wall and the length of the dust-guard slot, these conditions should be kept in mind, as well as the dimension 'J,' which is a lapping of the dust guard over the hole in the back of the box when the dust guard is moved over to the extreme side by the dust-guard seat of the axle striking the wall of the box."

This is referred to the committee on car trucks.

Distance Between the Backs of the Flanges of Car Wheels.

Page 535, Sheet M. C. B. 16.

10. A member suggests adding paragraph as follows:

"In 1909 the minimum distance permissible between the backs of flanges at base line of tread was fixed at 4 feet 5 3/32 inches."

Omitting the words "Modified 1909" from the third paragraph.

The committee concurs in this recommendation.

Brake Head and Shoe.

Page 541, Sheet M. C. B. 17.

13. A member calls attention to the fact that the location of the lugs from the vertical dimension line are not correct when the head is developed from the radial center line as located, as indicated by sketch accompanying.

The committee concurs in this recommendation.

Automatic Coupler.

Page 627, Sheet M. C. B. 23.

18. A member suggests to amend the specifications for M. C. B. couplers so as to admit as an M. C. B. standard couplers having the underneath uncoupling arrangements, calling attention to paragraph 4 of this page.

The committee refers this to the coupler committee.

Pages 622 to 624, Sheet M. C. B. 23.

19. A member suggests that reference be made in the text to the authority for the temporary coupler having 12¼ inch head.

The committee concurs and advises that this will be taken care of in the 1912 proceedings, on authority of result of the special letter ballot.

Signal Lamp Socket.

Page 639, Sheet M. C. B. 26.

20. Through the secretary the following communication from the American Railway Association was received:

"With the introduction of steel cars for passenger train service, it is found that the method of mounting the brackets for carrying the markers of trains is becoming mechanically so uncertain and irregular as to seriously interfere with the proper display of markers as protective signals.

"There is apparently no system governing the mounting of these signals, some being placed upon the corners of the roof, some high up and others about midway of the corner posts of the cars; while the castings used for the sockets on the cars and the brackets of the lamps are frequently rough, and so crudely fitted that the lamps cannot be accurately sighted.

"The method of attachment appears to be to use some of the rivet holes which happen to be in the steel plates, for the purpose of riveting on the signal brackets, without regard to whether the brackets when so riveted up are in a right position to properly sight the markers.

"There is also found to be a variation in the angle of the axis of the bracket with the center line of the car. The western roads use an angle of 45°, while the Pennsylvania Railroad and many others of the eastern lines use an angle of 14° 10′.

"The lamp manufacturers, in their endeavor to make lamps suitable for the different styles of brackets on the cars, notch out the lamp holder so that it may be set accurately to an angle of 45°. They then with the notches subdivide the arc into three sections of 15° each, which arrangement does not fit the Pennsylvania angle of 14° 10′ by a variation of 50′. With the increasing high power of marker lamps it becomes more important than ever to have them set accurately in position to effectively perform their primary function of rear protection, and the sighting of a marker attached to the rear of a train is just as important as the proper sighting of a block signal or a train-order signal.

"In the matter of the safe operation of trains at night the efficient use of the train markers is of such vital importance that it should receive most careful attention, and I would suggest that the committee on transportation take up this subject, and arrange for standard specifications for the attachment of the markers to all classes of cars in both passenger and freight train service."

The committee recommends locating socket at a 45° angle, located on the corner post, and approximately 9 feet 6 inches from the rail to the bottom of the slot of socket.

Siding, Flooring, Roofing and Lining.

Page 639, Sheet M. C. B. 26.

23. A member calls attention to the fact that with the present standards for tongue and groove in siding, roofing, lining and flooring it is impossible to drive up and make a tight joint on the face side, and suggests that it be cut back 1/32 inch on the under shoulder tongue edge.

The committee concurs in this recommendation.

Signal Lamp Socket.

Page 639, Sheet M. C. B. 26.

24. A member calls attention to the ommission of dimension showing the length of slot, and suggests that same be given.

The committee agrees with the suggestion and instructs the secretary to make the insertion, showing this as 3⅜ inches.

Page 639, Sheet M. C. B. 26.

25. A member calls attention to the title, "Signal Lamp Bracket and Socket."

The committee agrees that this is an error and instructs the secretary to correct to "Signal Lamp Socket" in both text and sheet.

Splicing of Steel Center Sills.

Page 643, Sheet M. C. B. 28.

26. A member calls attention to the wording in the first line of the second paragraph, "The space for center sills," should be changed to, "The splice for center sills."

The committee concurs in this recommendation and the secretary is requested to make the change.

27. A member calls attention that paragraph two conflicts with Sheet M. C. B. 28.

The committee agrees, and the secretary is instructed to change the sheet reference, to M. C. B. 28.

28. A member calls attention to the second paragraph and the following paragraph, which refer to Figures "A" and "B" for method of splicing center sills, in that the cuts on Sheet M. C. B. 28, showing the splicing of steel center sills, give the length of the reinforced plates as 14½ inches. The length of the protruding end, while not given, is presumed to be 8 inches. The text specifies two joints to be reinforced by plates on both sides to be not less than twice the length of the protruding end; therefore, the reinforced plate, shown on this cut, should be at least 16 inches, instead of 14½ inches.

The committee concurs with the suggestion, but recommends changing the text, paragraph two, to show 7 inch projection, instead of 8 inches, so as to conform to the figures in cuts "A" and "B."

Pamphlets, Catalogues, Specifications, Etc.

Page 649.

29. A member writes as follows:

"I recently had the matter of standard size for specification and letter-head paper to consider in connection with some government boiler reports, and comparing these with the Master Car Builders' standards as adopted, I notice there are a great variety of sizes used.

"The M. C. B. size for specifications and letter-heads is 8¼ by 10¾ inches.

"I find we ourselves use Form 82, size 8⅜ by 11 inches. This is padded.

"The government uses a demy letter-head, 8 by 10½ inches.

"Printer's letter-head size is 8½ by 11 inches.

"As the M. C. B. specification does not seem to agree with anything that I have to do with, I am writing for information and ask why it should differ from that used by the government.

"Personally, being a great believer in standards, I recently had a form printed specified to be M. C. B. size, and gave an order to have a lot of frames made the same size, but when the paper was furnished by the printer it was ⅛ inch wider and ⅛ inch longer than was specified."

The committee recommends the adoption of the government's standard, 8 by 10½ inches.

RECOMMENDED PRACTICE.

Sheet M. C. B.—A.

31. A member calls attention to this plate and refers to M. C. B. Sheet 8-A.

The committee admits error in 1911 Proceedings, and instructs the secretary to omit it.

Sheet M. C. B.—E.

32. A member calls attention that the brake chain was removed and advanced to standard, but sheet not marked "Revised 1911."

The committee agrees and instructs the secretary to make necessary correction.

Box Car Side Door and End Door Fixtures.

Page 726, Sheet M. C. B.—F.

33. A member calls attention to the door-hasp staple plate as shown in details 16 inches long, while on door as 5⅜ inches, the 17 inch length being rejected by letter ballot in 1911.

The committee agrees that it was an error in showing this as 16 inches, in view of its rejection, but at the same time renews its recommendation to the Association for the 16 inch style, with four bolts.

Box Car Doors.

Sheets M. C. B.—F and F-1.

34. A member suggests advancing Sheet M. C. B.—F, showing box car outside hung door, and Sheet M. C. B.—F-1, showing box car flush side door, to standard.

The committee concurs in this recommendation.

Marking of Freight Cars.

Page 641, Sheet M. C. B.—G.

35. A member suggests that this sheet be changed to show three stars following the stenciling of weight of car. This to correctly indicate the final light weight of car.

The commitee would recommend that the following paragraph be incorporated in the text, paragraph B, of M. C. B. Rule 30, as follows:

"Wooden and steel underframe cars one year old should be reweighed and restenciled, the weight to be followed by one star; cars two years old should be again weighed and stenciled, the weight to be followed by two stars; cars three or more years old should be again weighed and stenciled, the weight to be followed by three stars, which will indicate final weight."

36. A member calls attention to the minimum height of 1 foot 10½ inches from center line of coupler to bottom of number, being insufficient to properly locate lettering on steel underframe gondola cars, and suggests that this be made 1 foot 5 inches.

The committee concurs in this recommendation.

High Speed Foundation Brake Gear for Passenger Cars.

Page 723, Sheets M. C. B.—J. K. and L.

37. A member calls attention that the hand brake shown does not operate in harmony with power brakes, and that diagram shown thereon should be changed.

The committee has already referred this to the train brake and signal committee. (See 1911 Proceedings.)

Cast-Iron Wheels.

Page 538, Sheets M. C. B.—N, O and P.

38. A member calls attention that the seventh paragraph should be changed so as to include the modified form of wheel gauge, Proceedings 1909 and 1911.

The committee agrees that the wording should be changed, omitting the date reference and to read as follows:

"The thickness of the flange shall be regulated by the maximum and minimum flange thickness gauges adopted by the M. C. B. Association."

Pages 536 to 539, Sheets M. C. B.—N, O and P.

39. A member suggests that a note be added indicating that the broken line show changes.

The committee agrees that the cuts are in error and instructs the secretary to make the necessary corrections.

Lumber Specifications.

Pages 742 to 787.

40. A member calls attention to the lumber specifications, raising question as regards their intent with special reference to allowable defects, taking into consideration the length of piece. For instance, in purchasing siding in lengths of from five to eighteen feet, with the specifications as they stand, would the same number of defects be allowed in a five-foot piece as in an eighteen-foot?

This was referred to a member of the committee having in hand the lumber specifications, with advice to the effect that it was the intention of the committee that the allowable defects laid down in the specifications were for standard lengths of lumber, and the committee concurs in this opinion.

Classification of Cars.

Page 733.

41. A member suggests designations for certain kinds of refrigerator and ventilator cars, which have been described by the Railroad Refrigerator Service Association, as follows:

Symbol.	Kind of Car.	Description.
"RS"	Standard Refrigerator.	Equipped with insulation, ice tanks and ventilating devices.
"RA"	Meat and Provision Refrigerator.	Equipped with insulation and brine ice tanks without ventilating devices.
"RB"	Beer and Ice Refrigerator.	Body and doors equipped with insulation, having no ice tanks or ventilating devices.
"VS"	Standard Ventilator.	Equipped with insulation, including insulated side, end and top openings, and ventilating devices without ice tanks.
"VA"	Vegetable Ventilator.	Equipped with insulation, but having common box car end and side doors which afford no protection against heat or cold.

This is also suggested by the Association of Transportation and Car Accounting Officers.

The committee concurs in this recommendation.

NEW SUBJECTS.

43. In accordance with action of this Association, 1911 convention, with respect to the establishment of a maximum standard or limiting height for the running-board of a standard dimension box car—

The committee, after careful consideration of this, believes that this is governed by the height of the brake staff as referred to on page 564 of the 1911 proceedings, which fixes this at 14 feet, and with this in mind and the clearances for the brake wheel as established by the United States safety appliance standards, determines the maximum height of running-board for the various construction of roof, and, therefore, does not concur in the suggestion.

44. The Arbitration Committee suggested that a committee be appointed to show the location and design for repair and defect card boards on steel cars, and which was referred to this committee by the Executive Committee, and included in our Circular of Inquiry, M. C. B. 14, under date of December 11, 1911.

The committee receiving only two responses, your committee with the information at hand did not feel that they had sufficient data as to the various styles of steel cars to enable a report at this time, and the matter is, therefore, referred to the association for further instructions.

(Signed)

C. E. Fuller,
W. H. V. Rosing,
W. E. Dunham,
S. M. Hindman,
O. C. Cromwell,
T. M. Ramsdell.
(Signed) T. H. Goodnow,

Discussion.

F. F. Gaines: I think the fact that we already have too many standards is an excellent argument for re-submission. The 8½-in. coupler butt is used all over the country, and I move that the report be submitted to letter ballot.

C. A. Schroyer: I am opposed, as we will have to carry in stock a $1.50 bar to replace $1.25 spring.

R. L. Kleine: We are successfully using the 8-in. spring, and I hope that the motion will not prevail. If it does, it means that the Pennsylvania will have to carry four times as many couplers in stock as at present.

C. A. Schroyer: We have standard butts of 6½ in. or 9¼ in., and I see no reason why we should go to a spring half way between.

R. L. Kleine: You can use an 8-in. butt with an 8-in. spring and scarcely tell the difference.

J. J. Hennessey: If you use an 8½-in. butt where a 9⅛-in. spring is used, it will be necessary to change the yoke.

Mr. Gaines' motion was put and lost.

J. J. Hennessey: In the drawing they show a key for a 5x9-in. journal box. I would like to ask the committee if they intend to destroy the rocking motion.

T. H. Goodnow: No, we wish to increase it.

J. J. Hennessey: Is not the rocking motion destroyed?

T. H. Goodnow: No, that was not so much for the rocking motion as it was to allow clearance in removing the wedge.

C. A. Schroyer: The rocking motion wedge is entirely destroyed by the use of that lug unless there is a recess at the top of the box. If there is, you increase the difficulty in removing the wedge, as the box must be jacked up that much higher.

Henry La Rue: I wish to call attention to paragraph 20. It has been the understanding on the Rock Island for the past four

years that the bracket should be over on the letter board. I dislike to see these put down on the corner posts as low as that. I believe the 45-degree angle to be correct.

T. H. Goodnow: We took the Pullman Company's recommendations as their cars are most generally interchanged.

Henry La Rue: The Pullman Company has no standards but conforms to the standards of the roads over which it operates.

C. A. Schroyer: This report corresponds with North-Western practice, I am glad to note. The Pullman got it from the North-western, and the Pennsylvania from the Pullman. I think that your report is all right.

R. L. Kleine: I move that the recommendations be referred back to the committee.

D. E. Fitzgerald: The question of the location of lamp brackets arose on the 'Frisco about two months ago. A large number of our engineers say that the view of the lamp at night in that location, is clouded. There is the same tendency where you have it on observation cars. Before we decide on the location definitely, the question of safety ought to be given consideration. Several months ago a wreck occurred, and at the time it was said that if the lamps had been located a little higher, the engineer would have seen them. However, on account of a dip in the track he could not see the tail lights.

R. L. Kleine: The committee recommends that the socket be located on a 45-degree angle. The location of the socket on this angle will depend on the round of the corner post.

Wm. Garstang: Has the committee conferred with the American Railway Association?

C. A. Seley: This is a transportation matter rather than a mechanical matter. Mr. Fitzgerald's remarks emphasize this fact, and I am in favor of a further conference with the American Railway Association. The discussion has brought out the fact that there are two locations in general use.

A motion was made and seconded that the report of this committee be received, and the recommendations with the exception of the lamp bracket and socket, be accepted.

H. H. Vaughan: Referring to section 43 on the question of new subjects. We find that the height would only be limited to 13 feet 10⅝ in. This subject is important to us, as we have legislation in Canada with respect to the height of clearances demanded. Generally speaking, this matter is outside of the car department. However, we can fix the height for standard box cars, and we would like to have it 13 ft. 6 in. We should be able to regulate the height of running board as well as the height of the brake rod.

T. H. Goodnow: In considering this, one of the questions which came up was that of the longitudinal running board in connection with an outside metal roof. This would increase the height of the car at the eaves and effect the height of the box car at that point. We are limited by the safety appliance standards, and to go any further would be tying it down pretty tight.

H. H. Vaughan: The height of the eaves is not under discussion, it is the height of the running board. I move that this matter be referred back to the committee.

This motion was carried.

TRAIN BRAKE AND SIGNAL EQUIPMENT.

Standards for Air Brakes on Freight Cars.

This refers to report of committee on standards, 1911, Item 12. It was suggested that the double hand-brake arrangements shown on sheet M. C. B. 18 do not conform to requirements of Interstate Commerce Commission and should be made to work with the air. Your committee has revised sheet 18 as suggested, showing the addition of a hand-brake lever connected to the cylinder lever with a chain in a manner that gives the same hand-brake power at each end of car as that given by the single hand-brake arrangement. On account of the crowded condition of M. C. B. Sheet 18, the details had to be rearranged.

High-Speed Foundation Brake Gear.

Report of committee on standards, Item 48. That Sheets M. C. B. "J," "K" and "L" be referred to the Committee on Train Brake and Signal Equipment for revision to conform to the safety-appliance standards, which provide that the hand brake shall operate in harmony with the power brake. Your committee has revised Sheets "J," "K" and "L" as instructed. The revision contemplates a minimum of changes on old equipment. The cylinder is reversed, bringing the push rod at opposite end from that previously shown; cylinder lever is chain-connected to one end of the hand-brake lever. On new equipment the use of the floating lever fulcrum connection and chain may be discontinued and a fulcrum similar to that shown for the intermediate lever, Sheet "J," can be substituted for these details on either of the three Sheets "J," "K" or "L." The hand-brake power is to be multiplied by means of a floating chain sheave on hand-brake connection rod.

Method of Marking Brake Apparatus Cleaned, Oiled and Tested.

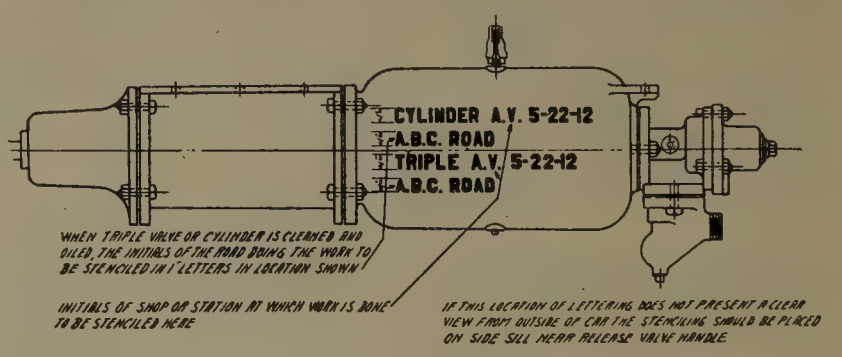
The arbitration committee suggested that the stenciling should be illustrated in the rules, and directed that your committee submit drawing showing how this should be done. Your committee has prepared for this purpose an illustration. In order to condense the stenciling as much as possible, the words "Cleaned and oiled," and "tested," have been omitted, as their significance is well known by all concerned.

Coupler Failures Chargeable to Failures of the Brake Apparatus.

The coupler committee requested that a representative be assigned from this committee to assist them in their investigation. Mr. Burton was given this assignment.

Frequent Cleaning of Triple Valves.

This subject was introduced at the convention by Mr. Wilden last year. Since that time Mr. Wilden has reported to the committee sixty-six specific cases between December, 1909, and June, 1911, where triples on N. Y., N. H. & H. R. R. cars were cleaned and tested more frequently than that required by the rules, involving an average cost of 81 cents per cleaning. Your committee, after investigating this subject, has no recommendations to make other than the proper stenciling and information required on the repair card as provided for in the Rules of Interchange.


CYLINDER A.V. 5-22-12
A.B.C. ROAD
TRIPLE A.V. 5-22-12
A.B.C. ROAD
WHEN TRIPLE VALVE OR CYLINDER IS CLEANED AND OILED, THE INITIALS OF THE ROAD DOING THE WORK TO BE STENCILED IN 1" LETTERS IN LOCATION SHOWN
INITIALS OF SHOP OR STATION AT WHICH WORK IS DONE TO BE STENCILED HERE
IF THIS LOCATION OF LETTERING DOES NOT PRESENT A CLEAR VIEW FROM OUTSIDE OF CAR THE STENCILING SHOULD BE PLACED ON SIDE SILL NEAR RELEASE VALVE HANDLE
ABCDEFGHIJKLMNO
PQRSTUVWXYZ &.
1234567890

Marking of Cleaned Brake Apparatus.

Passenger Train Line.

A suggestion was made by the President that this committee consider the question of 1¼-inch instead of 1-inch train line pipe for passenger-train cars. The committee took up this question with the air-brake manufacturers, with the idea of having tests made, if necessary, to determine what effect the enlarged pipe with its increased volume of air would have on the performance of the brake apparatus. The data required will not be assembled in time to make recommendations to the convention this year.

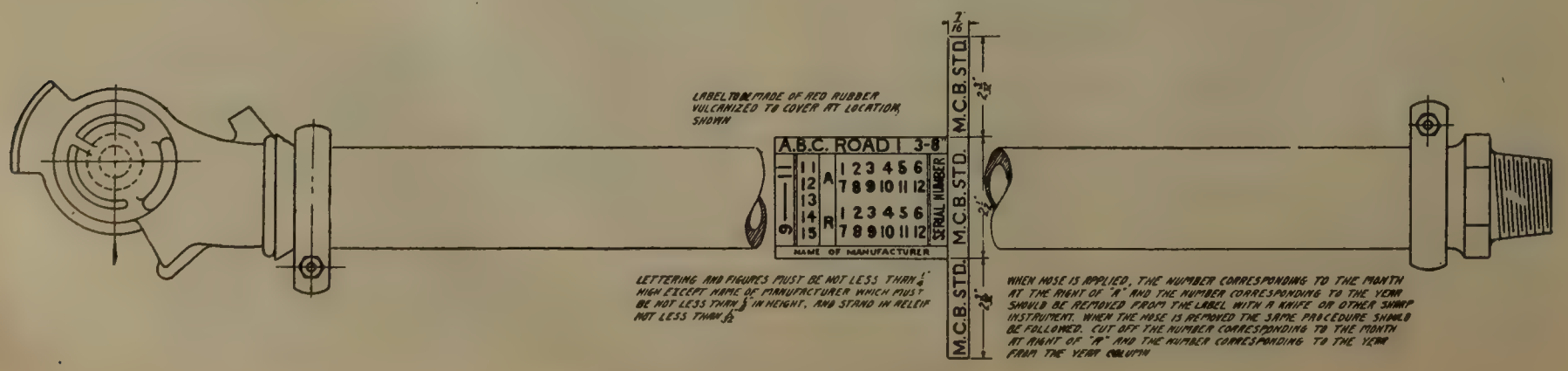
M. C. B. Hose Label.

The arbitration committee referred to this committee the advisability of adopting and having copyrighted a characteristic badge or label for M. C. B. hose, which should be of such form and in such location as to be readily observable by the inspector without going between the cars, and permission to use such label to be given the manufacturers only on their request. Your committee finds that a copyright, such as suggested, cannot be obtained by the association, which is a non-incorporated body, but has prepared a drawing showing that portion of the standard label marked "M. C. B.," extended so as to completely encircle the hose. This would make the label distinctive and readily observable without the necessity of going between the cars. If the proposed change in label were adopted by the association, your committee would further recommend that Rule 58 be modified to read: "On and after September 1, 1915, delivering line responsible for hose not so labeled."

Signal-Hose Coupling.

The executive committee referred to this committee the following communication from a member:

"There have been several cases where the efficiency of the air-


LABEL TO BE MADE OF RED RUBBER VULCANIZED TO COVER AT LOCATION SHOWN
A.B.C. ROAD 3-8
SERIAL NUMBER
NAME OF MANUFACTURER
M.C.B. STD.
M.C.B. STD.
M.C.B. STD.
LETTERING AND FIGURES MUST BE NOT LESS THAN ¼" HIGH EXCEPT NAME OF MANUFACTURER WHICH MUST BE NOT LESS THAN ⅜" IN HEIGHT, AND STAND IN RELIEF NOT LESS THAN 1/32
WHEN HOSE IS APPLIED, THE NUMBER CORRESPONDING TO THE MONTH AT THE RIGHT OF "A" AND THE NUMBER CORRESPONDING TO THE YEAR SHOULD BE REMOVED FROM THE LABEL WITH A KNIFE OR OTHER SHARP INSTRUMENT. WHEN THE HOSE IS REMOVED THE SAME PROCEDURE SHALL BE FOLLOWED. CUT OFF THE NUMBER CORRESPONDING TO THE MONTH AT RIGHT OF "A" AND THE NUMBER CORRESPONDING TO THE YEAR FROM THE YEAR COLUMN

New Label for M. C. B. Hose.

brake system on passenger trains has been considerably reduced on account of the signal hose being coupled to the air-brake hose. When the signal-hose couplers are new it is very difficult to cause them to couple with the coupling on the air-brake hose, but when they become worn it is possible to make an imperfect coupling with ease."

The committee would recommend as a solution of this difficulty the adoption of a signal-hose coupling which would be exactly the same size and have exactly the same contour lines as the brake-hose coupling proposed to the convention last year and adopted by letter ballot, except that in its coupling feature the position of coupling lug and arm be reversed, making a left-hand coupling for the signal hose. Such a coupling could not be imperfectly coupled with the brake-hose coupling. The gaskets or rings would be the same, and there would need be no experimenting with the coupling or contour lines.

Air-Brake Hose.

The committee has had called to its attention the desirability of improving the air-brake hose conditions. The specification for air-brake hose has been in use since 1905, and does not appear to produce a satisfactory hose.

It would seem desirable to have this subject investigated by a special committee, giving attention to a revision of the specification requiring more severe stretching, pressure, unwinding and unwrapping tests, and also attention to the mounting of hose so as to produce a tight fit on the nipple.

Your committee regrets to announce the resignation of Mr. Burton from this committee, on account of relinquishing his connection with active railroad work, making him ineligible for membership in the association. Mr. Burton has been of great service to the committee and the association on account of his thorough knowledge on all problems concerning the air-brake equipment.

(Signed) R. B. Kendig,
R. K. Reading,
B. P. Flory,
E. W. Pratt.

Discussion.

T. L. Burton, a former member, was given the privilege of the floor during this discussion as he had been a member of the committee.

I. S. Downing: We have often found that where an air line was defective, we could couple on to the signal line and thus keep air on the train. If this was changed as the committee suggest, it would be impossible for us to do this. This has saved us a great many delays and transfers of passengers.

T. L. Burton: This question was given careful consideration by the committee when making their recommendations. A reducing fitting for such cases could always be carried in the hose rack of the baggage car. This could be inserted in the signal pipe or the brake pipe as found necessary. The committee did not think that the carrying of this fitting was any more objectionable than failures arising through improper coupling of hose.

F. F. Gaines: I move that the report be accepted and be referred to letter ballot.

E. W. Pratt: It is sometimes very convenient to make a wrong coupling in order to save a few minutes on a train which is specially made up. However, it is a more serious matter when you are going into an open draw with a false coupling made unintentionally. Where there are other ways of overcoming this proposition, it is well to consider them.

The motion of Mr. Gaines was carried.

TESTS OF BRAKE SHOES.

As has been the case for the past two years, this committee has considered the subject of brake-beam standards as well as that of testing brake shoes.

Brake Shoes.

In its report of last year, the committee made the following recommendation:

"1. That some further work be undertaken by the association for the purpose of connecting the results obtained under high brake-shoe pressures with those upon which the association's specifications are based."

This recommendation was referred to the executive committee. Previous to 1911, the tests on brake shoes had been confined to pressures of 2,808, 4,152, 6,840 and 12,000 pounds, and to speeds of 20, 40 and 65 miles per hour.

The tests made by the committee last year at a speed of 80 miles per hour and at pressures of 12,000, 14,000, 16,000, 18,000 and 20,000 pounds established new standards for high-pressure and high-speed service.

In order to complete the series and to furnish data for high-pressure specifications, it is desirable that some further tests of an intermediate character should be made on the shoes tested last year.

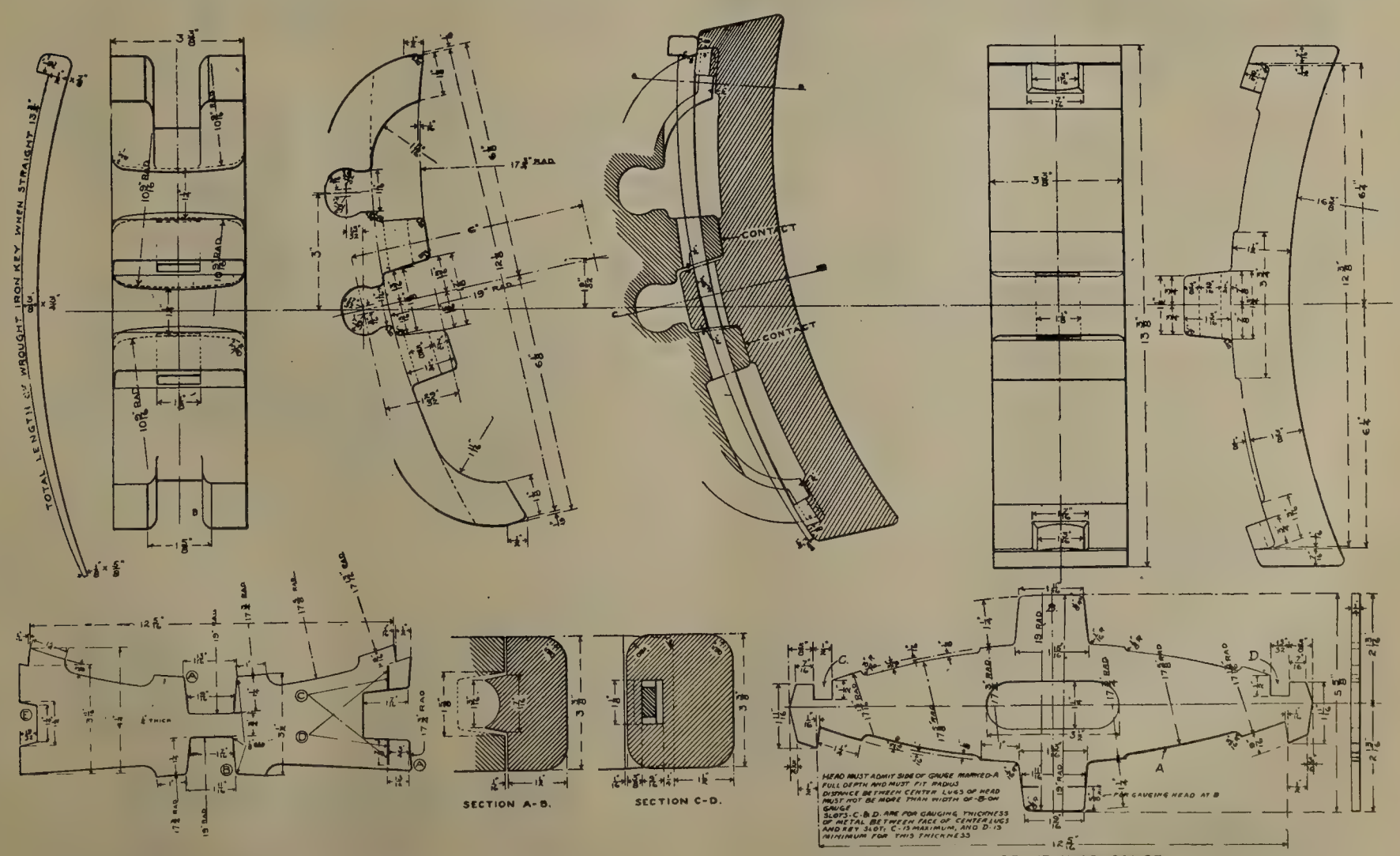
The committee accordingly recommended for this year's program tests on these same shoes at a speed of 65 miles per hour and at pressures of 12,000, 14,000, 16,000 and 18,000 pounds.

The pressure of 20,000 pounds is not included, since the results obtained last year show that no practical advantage attends the use of pressures higher than 18,000 pounds.

The committee further recommended that from the data thus obtained, specifications should be prepared covering the use of shoes in heavy passenger work.

For various reasons, the executive committee of the association did not find it expedient to appropriate money this year for these experiments and accordingly no work has been done.

In view of what has been said above, the committee feels that further tests should be made to complete the series and render


TOTAL LENGTH OF WROUGHT IRON KEY WHEN STRAIGHT 13"
CONTACT
CONTACT
SECTION A-B.
SECTION C-D.
AA-IS MAX. WIDTH FOR CENTER LUG
B-IS MIN. WIDTH FOR CENTER LUG
LINE C-IS MIN. HEIGHT OF SLOT IN CENTER OF LUG MEASURED FROM BACK OF SHOE
LINE D-IS MAX. HEIGHT OF SLOT IN CENTER OF LUG MEASURED FROM BACK OF SHOE
E-IS MAX. THICKNESS OF END LUGS ON BACK OF SHOE
BRAKE SHOE GAUGE.
BRAKE HEAD GAUGE.

MASTER CAR BUILDERS' ASSOCIATION.

STANDARD BRAKE HEAD, SHOE AND KEY.
STANDARD GAUGES FOR BRAKE HEAD & SHOE.

available for the purposes of the association the high-pressure work already done.

Weight of Fly-Wheel on Brake-Shoe Testing Machine.

During the discussion of the report of the brake shoe committee at the last convention, Mr. Burton raised a question as to the desirability of varying the weight of the fly-wheel on the testing machine so as to correspond to the brake-shoe pressure and thus keeping the per cent of braking power practically the same in the different tests. After some discussion, the question was referred to this committee for consideration.

The committee has considered the question and sees no good reason for making the change referred to. The fly-wheel of the machine was originally designed to store kinetic energy equivalent to that apportioned to one wheel of a 60,000-pound capacity freight car. Fortunately, this corresponds very nearly to the energy per wheel of a modern 12-wheel passenger coach weighing 145,000 pounds.

In testing a brake shoe under these conditions, the method adopted is the same that would be used in testing a freight car or passenger coach of the above weights at different speeds and brake-shoe pressures. The only effect of increasing the mass of the fly-wheel would be to lengthen the time of stopping and to heat the shoe to a higher temperature. This has the effect on some shoes of increasing the mean coefficient of friction and on others of decreasing it.

The committee does not feel that this would have any bearing on the question of the proper brake-shoe pressure to use under service conditions.

Recommendations.

In concluding this part of the report, the committee would make the following recommendations:

That further tests be made on the shoes tested last year to connect the results with those previously obtained.

These tests to be made at a speed of 65 miles per hour and at pressures varying from 12,000 to 18,000 pounds.

Discussion.

C. A. Seley: I move the recommendation of the committee as regards brake shoes be adopted. Carried.

Brake Beams.

Changes in Drawings.

The committee would recommend some minor changes in the drawings of brake head and beam as shown on sheet M. C. B. 17 and 17-A.

1. That the drawing of brake head on sheet M. C. B. 17 be so changed as to show the hanger hole straight with a radius of ⅜-inch at each end, to accommodate the straight hanger with filtered corners.

2. That the drawing of brake-beam gage as shown in sheet M. C. B. 17-A be so changed as to show an opening of 3½ inches instead of 3⅝ inches in order to make the drawing conform to the text of the specification as decided by letter ballot in 1907 (see proceedings for 1907, p. 545).

Length of Brake Beam.

In view of the present uncertainty and misunderstanding as to the standard allowances for length of brake beam, the committee would recommend the adoption of the following interpretation:

That the specifications as to length of brake beams, adopted by letter ballot in 1907, shown on page 558 of the proceedings, be interpreted as follows:

All brake beams shall be 60¼ inches in length from center to center of brake head, with a maximum allowable spacing of 60⅜ inches and a minimum of 60⅛ inches; this spacing to be measured by gauging inside of the brake head key lugs.

On sheet M. C. B. 17, the drawing of brake head shall be so changed as to show the hanger hole straight with ⅜ of an inch radius at the end.

Width of Slots in Brake Head.

The committee would recommend that the brake-head gauge shown in sheet M. C. B. No. 17A should be used for gauging the slots in the head with $1\frac{3}{16}$ as the minimum and $1\frac{1}{4}$ as the maximum width.

Brake Beam Gauge.

The committee would submit the drawing of a brake-beam gauge shown in sheet 17-A of this report for consideration and trial by members of the association, with a view of adopting such gauge as recommended practice to take the place of the present gauge now shown on sheet M. C. B. 17-A.

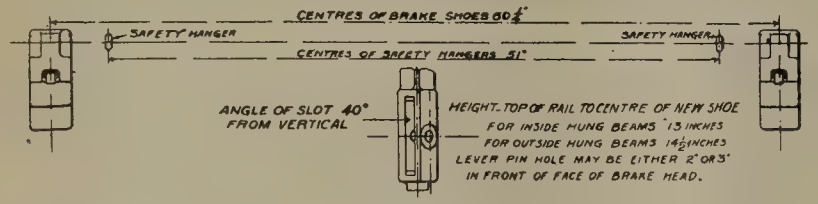
The proposed gauge determines the following dimensions and adjustments:

1. Limiting outline of brake beam.
2. Length of beam.
3. Proper alignment of the heads in relation to each other.
4. Proper location of pin hole and center of strut.
5. Angle of lever fulcrum.

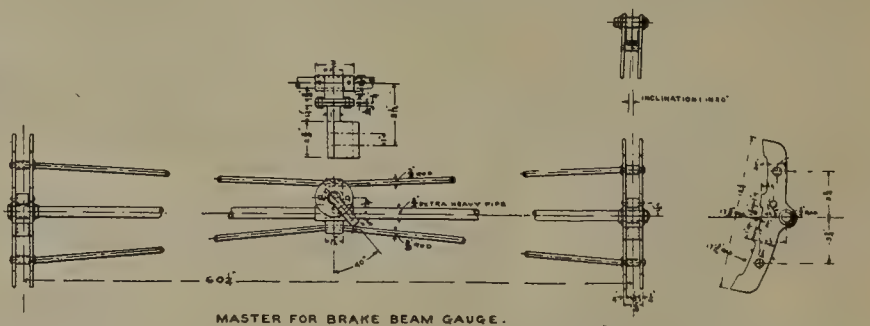
Standard Brake Beam.

The committee would also submit the drawing of a No. 2 standard brake beam shown in sheet 17-B of this report for consideration and trial by members of the association, with a view of adopting such beam as recommended practice for No. 2 M. C. B. brake beams. The committee understands that this beam can be made without incurring liability for patent infringement for any valid and existing patent. This brake beam meets all the requirements of the association so far as existing standards are concerned as to dimensions and also meets the physical tests required.

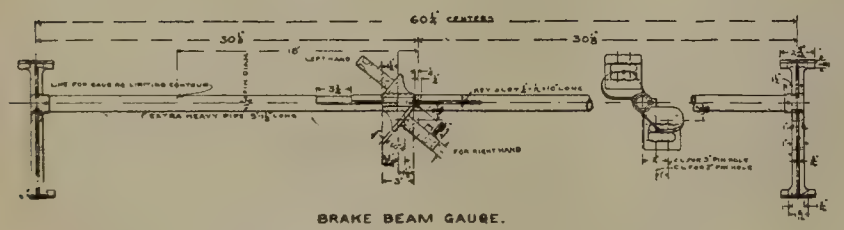
It is the feeling of the committee that the time is ripe for consideration of a standard beam which shall meet the present requirements and specifications.


CENTRES OF BRAKE SHOES 60¼"
SAFETY HANGER
SAFETY HANGER
CENTRES OF SAFETY HANGERS 51"
ANGLE OF SLOT 40° FROM VERTICAL
HEIGHT-TOP OF RAIL TO CENTRE OF NEW SHOE
FOR INSIDE HUNG BEAMS 13 INCHES
FOR OUTSIDE HUNG BEAMS 14½ INCHES
LEVER PIN HOLE MAY BE EITHER 2" OR 3"
IN FRONT OF FACE OF BRAKE HEAD.

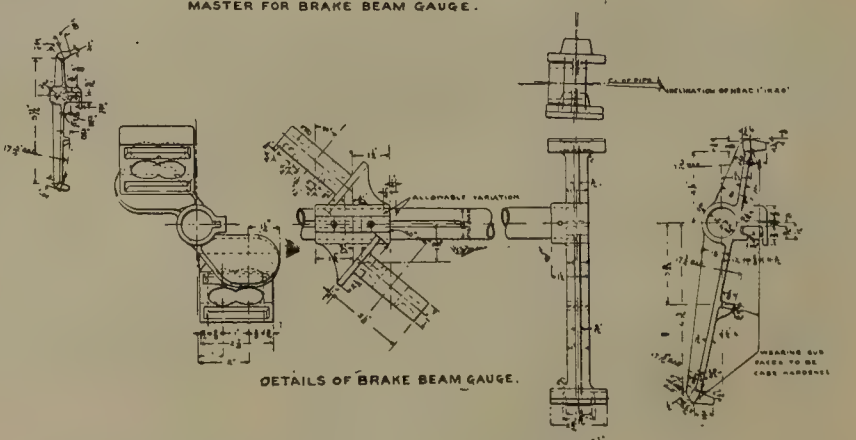
BRAKE BEAM.



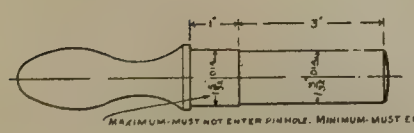
MASTER FOR BRAKE BEAM GAUGE.



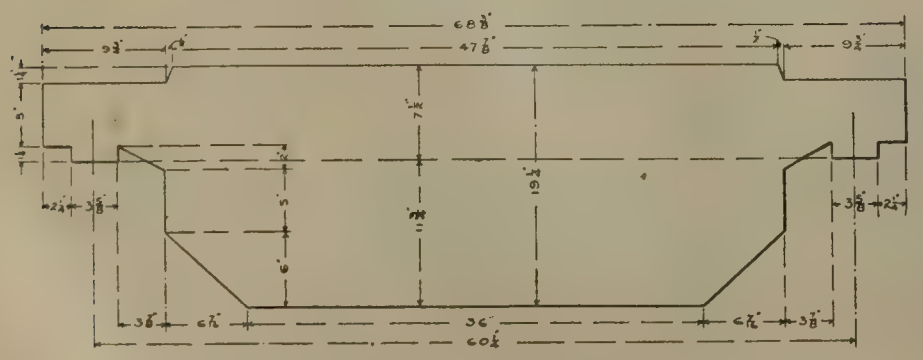
BRAKE BEAM GAUGE.



DETAILS OF BRAKE BEAM GAUGE.

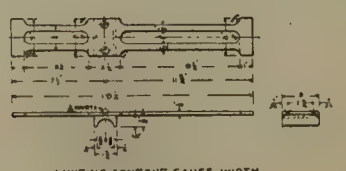


LEVER PIN HOLE GAUGE.

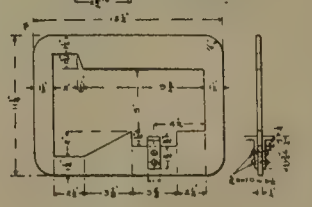


OUTLINES APPLY ONLY TO NO. 2 BEAM AND ONLY TO BEAMS USED ON CARS BUILT AFTER JANUARY 1, 1908.

LIMITING OUTLINE FOR BRAKE BEAMS.



LIMITING CONTOUR GAUGE-WIDTH.



LIMITING CONTOUR GAUGE-HEAD.

MASTER CAR BUILDERS' ASSOCIATION.

STANDARD BRAKE BEAM.
STANDARD BRAKE BEAM GAUGE.
STANDARD LEVER PIN HOLE GAUGE.
STANDARD LIMITING OUTLINE FOR BRAKE BEAMS.

1912 Revision of M. C. B. Sheet 17A.

Numbering Brake Beams.

It is recommended that in order to designate an M. C. B. brake beam, it be required that the letters "M. C. B.." and the numerals "No. 1" or "No. 2," as the case may be, be cast, forged or stamped on the fulcrum. It is further recommended that after January 1, 1913, this be cast on the fulcrum, if the fulcrum be a casting, or forged on the fulcrum if the fulcrum be a forging.

New M. C. B. Association Sheets.

In accordance with what has been said before, the committee would submit new M. C. B. association sheet No. 17 to be substituted for the existing M. C. B. sheet No. 17. The new sheet contains the standard brake head, shoe, key and gauges for same in accordance with the last ballot of the association. The gauge for head also shows the maximum and minimum lines for gauging the top and bottom of slot opening, with $1\frac{7}{8}$ inches as the minimum and $1\frac{1}{8}$ inches as the maximum width. One dimension has been added to the brake head, which is the width of the slot corresponding to the width of the slot in shoe, or $1\frac{1}{8}$ inches.

The committee would submit M. C. B. association sheet No. 17-A to be submitted for the present M. C. B. sheet No. 17-A. This sheet contains the standard brake beam, brake-beam gauge, pin-hole gauge and standard limiting outline for brake beams. The diagram of angle of slot in strut, position of brake heads, together with the pin-hole gauge, has been reproduced from the present M. C. B. association sheet No. 17-A. The limiting outline for brake beams has been modified in accordance with that shown on page 470, adopted in 1911 by the association as the new limiting outline for brake beams, and there has been substituted a new brake-beam gauge to take the place of the old gauge shown on this sheet, in accordance with suggestions of the committee, for the approval of the association. The committee would substitute a new sheet known as M. C. B. association sheet No. 17-B, which shows a proposed No. 2 standard brake beam with details, standard channel, strut and key-way gauges for both the 2-inch and 3-inch pin-hole dimensions in front of brake head. This is the brake beam referred to in the preceding paragraph and is one which will meet all the requirements of the association so far as existing standards are concerned, and will also meet the physical test required.

((Signed) C. H. Benjamin,
C. D. Young.
R. B. Kendig.

Discussion.

M. K. Barnum: The Illinois Central made an investigation of brake shoes coming to the scrap pile and found a great many worn flat on the face and a great many with the outside edge of the shoe overlapping the rim. Believe the present brake beam about ½ inch too long and would like to see the length changed to make the standard length 59¾ inches.

F. F. Gaines: We made an investigation of this matter eight or ten years ago and found that our experience was the same as Mr. Barnum's.

C. D. Young: I think it would be a mistake to adopt this suggestion without giving the committee a chance to consider and investigate. The committee on brake beams investigated this subject at one time and as we have had this practice in use for five years, I make an amendment that the subject of this dimension be referred back to the committee for further consideration.

Mr. Barnum accepted Mr. Young's amendment.

L. C. Ord: The Air Brake Association, I understand, has made an investigation of this subject and its committee made a recommendation of 60 inches for the length of the brake beam. Would it not be well to ask their committee to co-operate with ours?

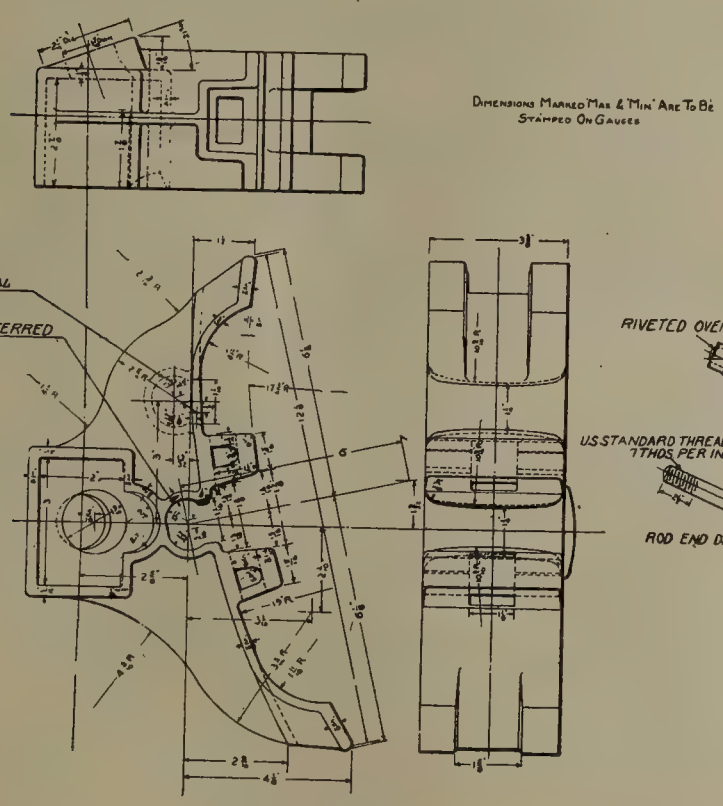
C. D. Young: Speaking for the committee, will say that we shall be glad to co-operate with the Air Brake Committee.

F. F. Gaines: We tried the matter out and found that we had less flange and brake shoe wear and that it worked better with the shorter dimension than with the nominal dimension.

C. A. Seley: I am glad to note the progress made in establishing a standard, but do not think we should adopt this beam as recommended practice at this time. It will pay us to spend more time in working out the analysis of a standard beam. A number of these dimensions are drawn too close, as for instance the radius of the compression member in the No. 2 beam. Ordinarily, I believe, this curve is made in assembling and some inspector might find an objection that it was not exactly a 50-inch radius. I move that the matter of a new standard beam be referred back to the committee for further consideration.

C. D. Young: It is impossible to build a beam in accordance with these requirements without giving the beam a ⅞-inch camber, which is virtually the same as a 50-foot radius. I believe the association should go slow, but I can't see what the committee can do for it has done its work and presented drawings and results of tests. Tests show this to be a 15,000-pound beam and the beam is amply strong to meet all requirements.

Mr. Seley's amendment was lost. The committee report was accepted and the question of length referred to letter ballot.



1912 Revision of M. C. B. Sheet 17B, Standard Brake Beam.

CAR WHEELS.

At the convention in June, 1911, a number of recommendations were made relating to questions of standardizing solid steel and steel-tired wheels for freight and passenger cars.

These subjects, together with other matters pertaining to the chilled cast-iron wheels were referred by the executive committee to the standing committee on car wheels for action and recommendation. The subjects before the committee are briefly outlined as follows:

Prepare specifications and physical test for cast steel, rolled steel, forged and rolled steel, and forged steel wheels.

Prepart drawings showing principal dimensions of cast steel, rolled steel, forged and rolled steel, and forged steel wheels.

Prepare drawings showing principal dimensions of cast steel, built-up steel-tired wheels.

Prepare drawing showing proposed M. C. B. standard gauge for measuring the thickness of service metal of solid steel and steel-tired wheels.

Consider any changes or corrections necessary in specifications for chilled cast-iron wheels.

The most important work that confronted the committee was the subject of specifications, dimensions and tolerances for solid forged and rolled, rolled or cast steel wheels for freight and passenger car service.

Your committee requested the various makers of solid steel and steel-tired wheels to submit drawings and specifications for steel wheels now in service; also requested similar information from railways using steel wheels.

Realizing the advisability of co-operation between railways and the makers of steel wheels, your committee addressed the manufacturers suggesting a joint conference at Pittsburgh, December 8, 1911.

At this meeting the following manufacturers were represented:
Forged Steel Wheel Company, represented by C. G. Bacon.
Standard Steel Wheel Company, represented by A. A. Stevenson.
Midvale Steel Company, represented by G. Criston.
Carnegie Steel Company, represented by J. C. Neale.
American Steel Foundries Company, represented by J. C. Davis.
Fried Krupp, represented by Thos. Prosser.
Railway Steel-Spring Company, represented by A. S. Henry.
Gerald Lomer, represented by V. Simpson.

The proposed work of your committee was explained to the manufacturers and met with general approval. It was brought out at this meeting that the present tendency pointed toward a number of different designs and specifications, instead of adopting as few standards as possible.

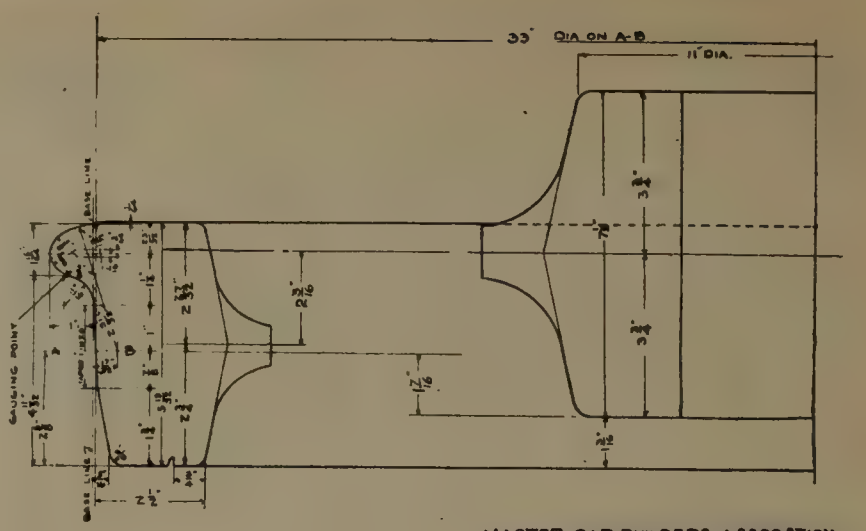
The committee was advised that a committee representing the wheel manufacturers and the American Society of Testing Materials was working jointly on designs and specifications for steel wheels.

Specifications were prepared by this committee for freight and passenger wheels, copies of which were furnished to your committee. After reviewing same, your committee recommended a few changes in regard to tolerances, and the revised specifications will appear as an appendix to this report.

After a careful study of these specifications, as well as those furnished by various railway companies, together with observations of wheels in service, your committee has come to the conclusion that the art of manufacturing solid steel wheels is yet in a process of development. There are a number of questions relating to the chemical and physical properties of carbon and alloy steel, and method of treating and handling the steel in its process of manufacturing that are now being investigated.

On this account, the committee has thought it unwise to recommend a standard specification at this time, governing the quality of the material or the method of manufacturing solid steel wheels, and has only recommended the adoption of a specification governing the maximum variations that will be allowed in the fabrication of new wheels. This is shown in recommendation No. 1.

It will be noticed that only one specification has been recommended which applies to both passenger and freight car wheels. Attention is also called to the fact that the question of specifications for cast-steel, one-run wheels has not been considered at this time.



The committee submits as its second recommendation, drawings of 33-inch and 36-inch solid steel wheels for freight and passenger service, as shown on exhibits A, B, C and D. As there is some difference in opinion as to the correct shape of the plate of the wheels, this has not been shown, and no mention as to thickness of plate and its tolerance is made in the proposed specification.

It will also be noticed that two different hub diameters—10 inches and 11 inches—are recommended for wheels used on axles up to and including 5½ by 10 inches, the use of either diameter to be optional with the purchaser.

On account of the necessity of allowing $\frac{1}{16}$ inch tolerance below the specified thickness of flange due to inaccuracy in fabrication, the committee suggests as its third recommendation that the thickness of flange be increased, making the rim $5\frac{1}{32}$ inches wide instead of 5½ inches, which is the present standard. This will make the contour of the tread and the flange of steel and steel-tired wheels same as the chilled cast-iron wheels, and the same mounting and check gauges can be used.

Attention is called to the drawings showing the various gauges that will be required in connection with the inspection of solid steel and steel-tired wheels.

In regard to the question of tire fastenings for steel-tired wheels, your committee has found that at the present time there are a great number of different methods used, and after careful consideration of this subject with the manufacturers of steel-tired wheels, it was suggested that a tire held by shrinkage and bolts be adopted as recommended practice as shown on exhibit N.

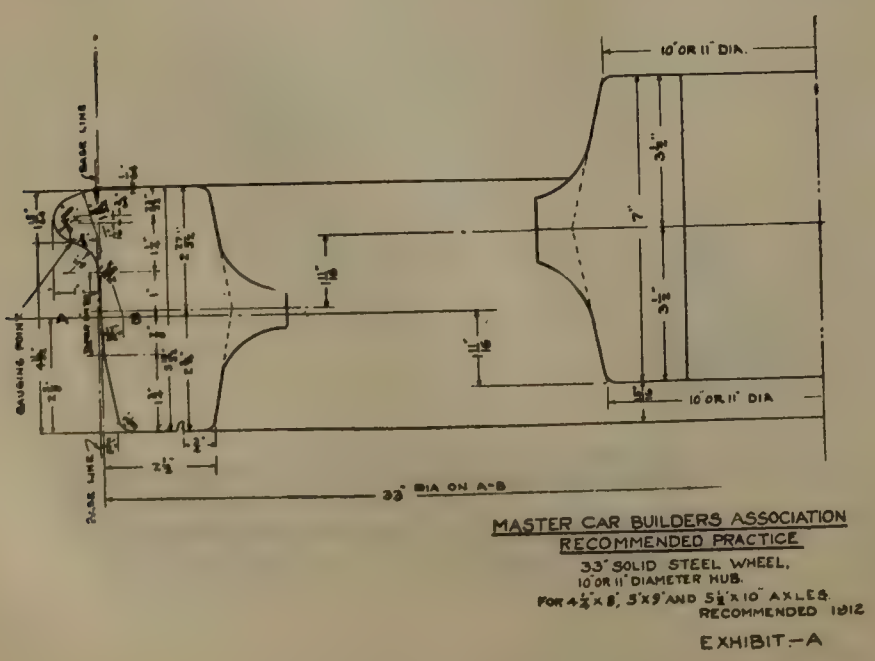
This type of fastening, in the opinion of your committee, has the greatest merits of any in use, and is not covered by patents, leaving it open for any manufacturers to produce. With this type of fastening cast-iron or cast-steel spoke or solid centers can be used.

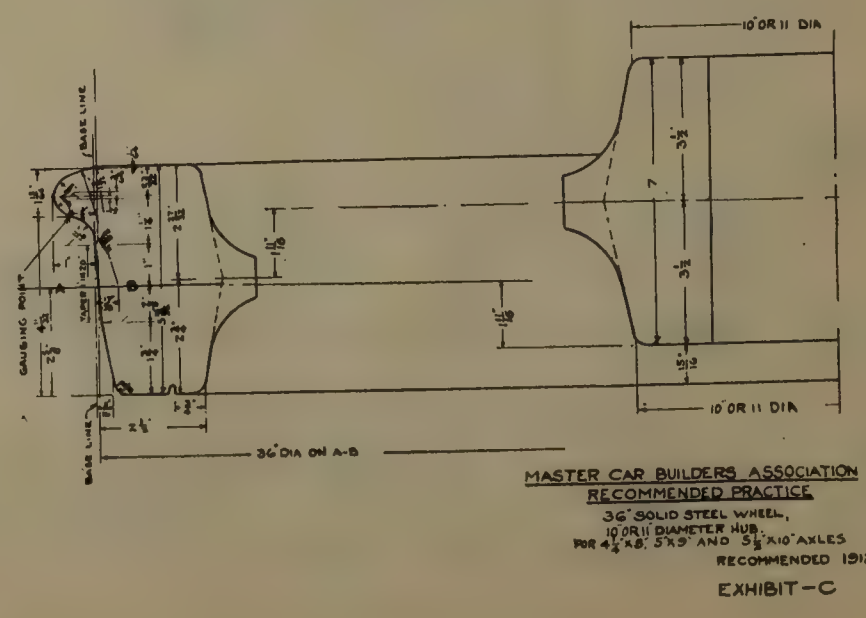
In regard to the question of determining a proper physical test for the purpose of detecting internal strains in solid steel wheels, your committee, after due consideration of this subject, feels that it will be necessary to make further investigations and experiments before submitting a recommendation, and suggests that this will be a part of the committee's work for next year.

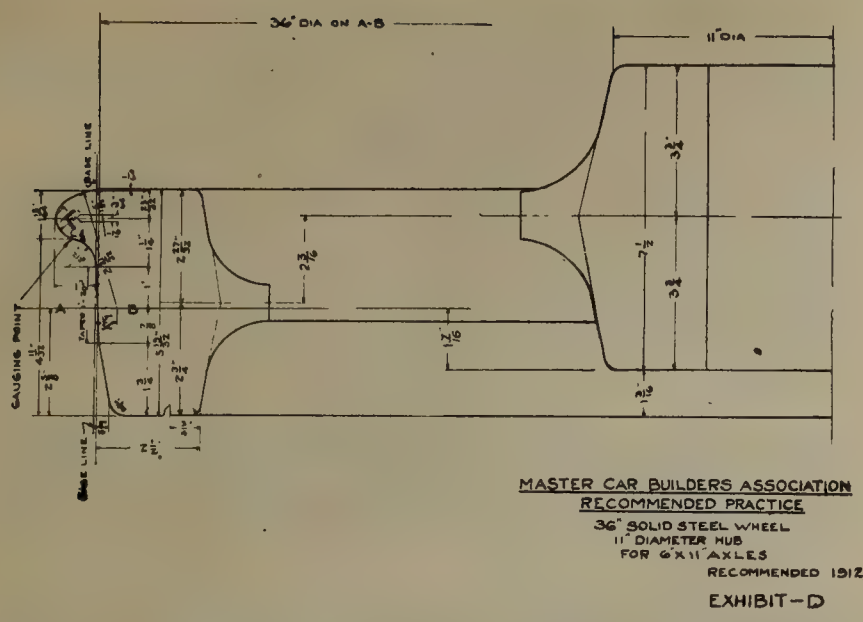
The question of branding wheels referred to in the proposed specification, and shown on drawing exhibit O, is recommended by your committee.

Chilled Cast-Iron Wheels.

In reference to chilled cast-iron wheels, your committee has


10" OR 11" DIA.
10" OR 11" DIA
33" DIA ON A-B
MASTER CAR BUILDERS ASSOCIATION
RECOMMENDED PRACTICE
33" SOLID STEEL WHEEL,
10" OR 11" DIAMETER HUB.
FOR 4½" X 8", 5" X 9" AND 5½" X 10" AXLES
RECOMMENDED 1912
EXHIBIT-A


10" OR 11 DIA
10" OR 11 DIA
36" DIA ON A-B
MASTER CAR BUILDERS ASSOCIATION
RECOMMENDED PRACTICE
36" SOLID STEEL WHEEL,
10" OR 11" DIAMETER HUB.
FOR 4½" X 8", 5" X 9" AND 5½" X 10" AXLES
RECOMMENDED 1912
EXHIBIT-C



received from the Association of Manufacturers of Chilled Car Wheels several suggestions, which are as follows:

1. Drawing for chilled cast-iron wheels for cars of 140,000 pounds capacity.
2. Increase thickness of flange $\frac{3}{32}$ of an inch at the base line, and compensate for this increase by mounting the wheels $\frac{3}{16}$ of an inch farther apart, and change the mounting gauge to suit.
3. Revision of weights of wheels for cars of 80,000 pounds capacity.
4. Revision of paragraph in wheel specification relative to overweight at the manufacturer's expense.
5. Revision of M. C. B. wheel specification to include wheels for cars of 140,000 pounds capacity.
6. Confine rejections on account of failure of test wheels to wheels represented by same tape size only.
7. Establish maximum breaking power as well as gross load for each design of wheel.
8. Revision of M. C. B. rule No. 76 to specify depth to which tread should be worn hollow.
9. Revise the M. C. B. standard drawings for cast-iron wheels to show the standard size core. Also revise the standard wheel specification to the effect that overweight of wheels above the normal (due to hub core smaller than the standard) should be paid for by the purchaser.

The committee has carefully considered the recommendations submitted by the Association of Manufacturers of chilled car wheels, and does not feel justified in recommending more than three of the changes at this time.

The question of increasing the thickness of the flange and mounting the wheels $\frac{3}{16}$ inch farther apart is a matter which this committee cannot pass upon or recommend. It was suggested that the Association of Manufacturers of chilled car wheels refer this question to the American Railway Association, as it will involve clearances in frogs and crossings, etc.

If it should be found advisable after investigating this matter with the American Railway Engineering Association, the committee will report on this at some future time.

In regard to the question of design and specification for a chilled cast-iron wheel for cars of 140,000 pounds capacity, your committee has taken no action on this subject at this time.

In regard to the question of raising the weight for the 80,000-pound capacity wheel, your committee has not found any good reasons for a change.

In reference to the suggestion relating to the overweight of wheels at the manufacturer's expense which is brought about by the clause in paragraph 9 of the present wheel specification, which reads :

"All excess weight over the maximum given to be the expense of the manufacturer."

Your committee has carefully considered this matter and recommends that paragraph 9 in the present wheel specification be changed as shown by your committee's recommendations.

In regard to suggestion No. 6, your attention is called to the present specification, which states that two wheels picked at random from each one hundred wheels be tested, and if these wheels fail to pass any of the specified tests, the entire lot of one hundred wheels represented by this test will be rejected.

It is asserted that the rejection of one hundred wheels because the chill in either extreme tape size is unsatisfactory causes many good wheels to be rejected and works a hardship on the manufacturers.

Your committee has carefully considered this matter, and a change in the specification is recommended to correct the same, as shown in your committee's recommendations.

In regard to the question of establishing maximum breaking power as well as gross load for each design of wheels, this question was brought up and referred to in our recommendations of last year and had particular reference to the failures of cast-iron wheels used under cars of heavy tare weight, such as refrigerator cars.

Your committee has considered this question again, and upon investigation found that the trouble experienced has been largely due to the fact that too light capacity wheels, as well as axles, are being used under refrigerator cars and cars with a marked capacity of 60,000 pounds. The majority of these cars have a tare weight of 40,000 to 47,000 pounds, bringing the total weight of the car and lading up to 117,000 pounds.

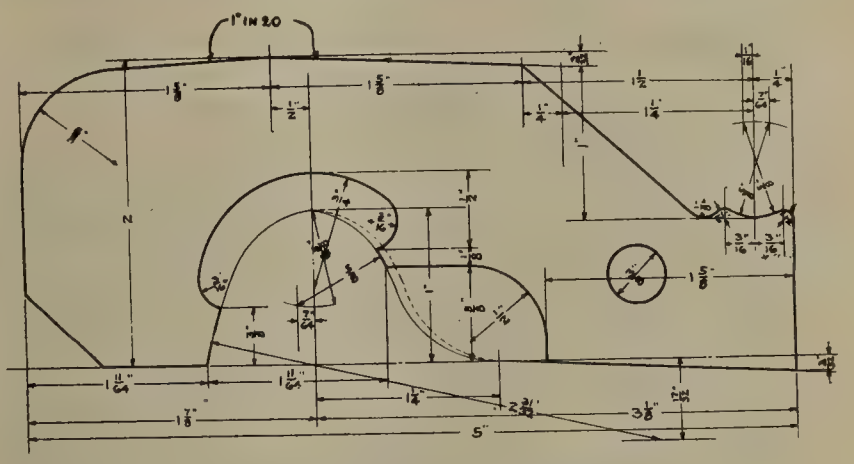
If the proper size axles, or 5 by 9, are used on these cars with a corresponding weight of wheels, it is the opinion of the committee that the trouble experienced with the above named cars will be eliminated, and we would again recommend that car owners and members of this association give this subject careful consideration in purchasing new equipment or making renewals to old cars.

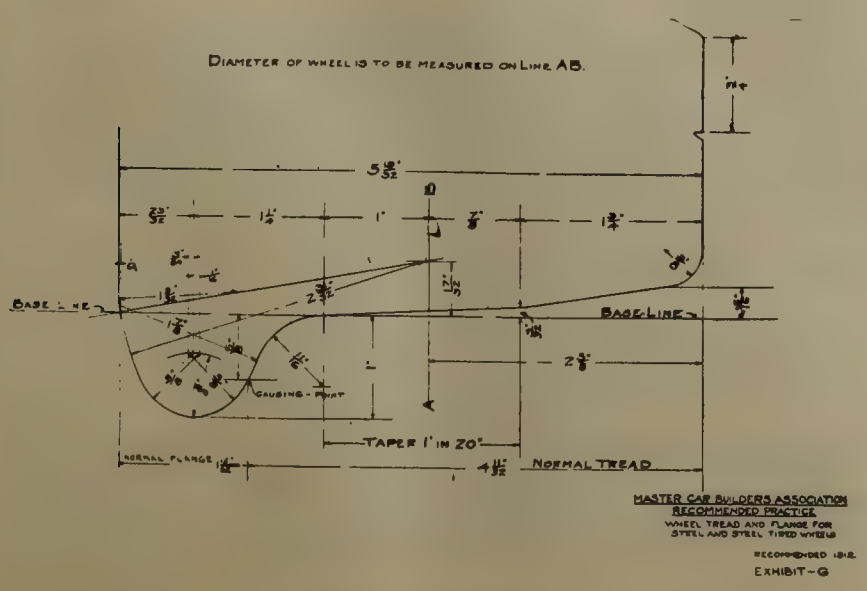
RECOMMENDATIONS.

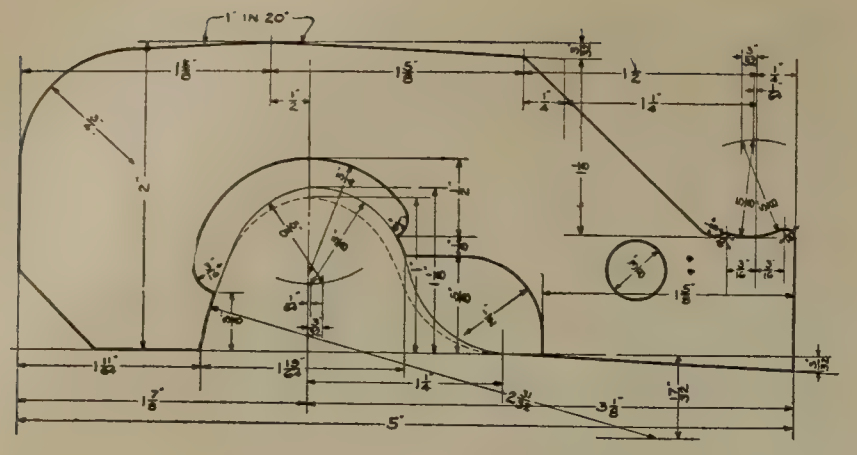
Recommendation No. 1.

The proposed specification governing dimensions and tolerances for solid wrought-steel wheels for freight and passenger car service are:

1. Wheels should be furnished rough bored and with faced hubs and have a contour of tread and flange as rolled or machined according to M. C. B. recommended practice (exhibit G). They should conform to dimensions specified.
2. Height of flange: The height of flanges should not be more than $\frac{1}{8}$ inch over and must not be under that specified, or 1 inch.
3. Thickness of flange: The thickness of flange shall not vary more than $\frac{1}{16}$ inch over or under that specified.
4. Thickness of rim: The thickness of rim to be measured between the limit of wear groove and the top of the tread at the point where it joins the fillet at throat of flange. The thickness must not be less than 1¾ inches, but may exceed this amount.
5. Width of rim: The width of rim shall not be more than $\frac{1}{8}$ inch less, nor more than $\frac{1}{8}$ inch over that specified.
6. Limit of wear groove: The limit of wear groove to be located as shown in exhibit G, M. C. B. recommended practice.
7. Diameter of bore: The diameter of rough bore shall not vary more than $\frac{1}{16}$ inch above or below that specified. When not specified the rough bore shall be ¼ inch less in diameter than the finished bore subject to the above limitations.
8. Hub diameter: The hub diameter may be either ten inches or eleven inches in diameter as specified, with a maximum variation of $\frac{1}{8}$ inch above or below. The thickness of the wall of the finished bored hub shall not vary more than $\frac{3}{8}$ inch at any two points on the same wheel.
9. Hub length: The length of hub shall not vary more than $\frac{1}{8}$ inch over or under that specified.
10. Depression of hub: The depression of the hub must be made so that the distance from the outside face of the hub to the line AB shall not exceed $1\frac{1}{8}$ inches for wheels used on 5½ by 10 inch axles and under and $1\frac{7}{16}$ inches for wheels used on 6 by 11 inch axles.
11. Black spots in hub: Black spots will be allowed within 2 inches of the face of the hub, but must not be of such depth that they will not bore out and give clear metal at finished size of bore.


1" IN 20
MASTER CAR BUILDERS ASSOCIATION
RECOMMENDED PRACTICE
MINIMUM FLANGE THICKNESS, HEIGHT AND THROAT RADIUS GAGE FOR SOLID STEEL WHEELS
RECOMMENDED 1912
EXHIBIT-I





MASTER CAR BUILDERS ASSOCIATION
RECOMMENDED PRACTICE
MAXIMUM FLANGE THICKNESS, HEIGHT AND THROAT RADIUS GAGE FOR SOLID STEEL WHEELS.
RECOMMENDED 1912
EXHIBIT—H

12. Eccentricity of bore: The eccentricity between the tread at its center line and the rough bore shall not exceed 3-64 inch.

13. Block marks on tread: The maximum height of block marks must not be greater than 1-64 inch.

14. Rotundity: All wheels shall be gauged with a ring gauge and the opening between the gauge and tread at any one point shall not exceed $\frac{1}{16}$ inch.

15. Plane: Wheel shall be gauged with a ring gauge placed concentric and perpendicular to the axis of the wheel. All points on the back of the rim equidistant from the center shall be within a variation of $\frac{1}{16}$ inch from the plane of the gauge when so placed.

16. Tape sizes: Wheels shall not vary more than five tapes under nor nine tapes over the size called for.

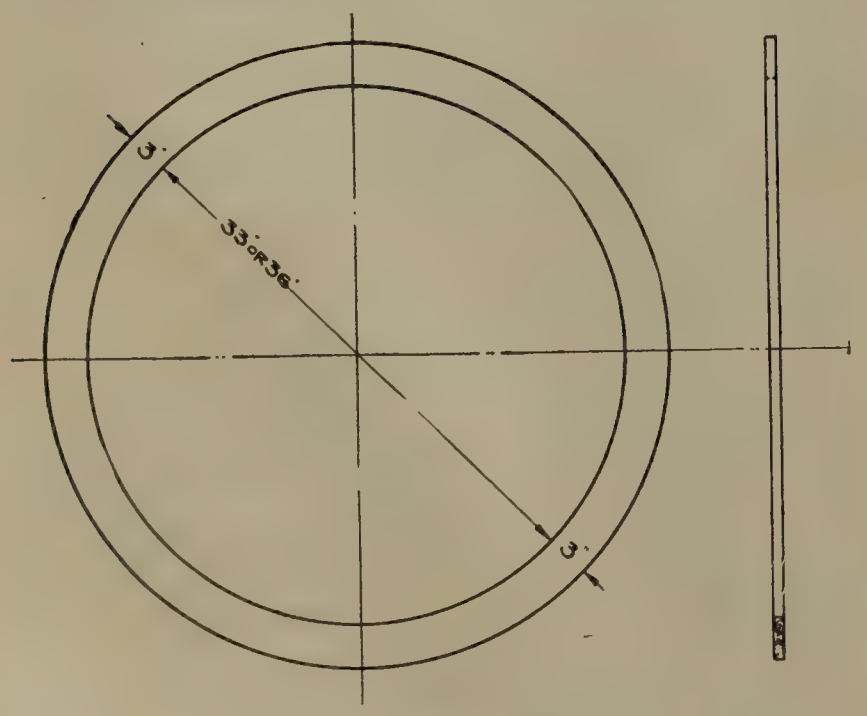
17. Mating: The tape sizes shall be marked in plain figures on each wheel. Wheels must be mated to tape sizes and shipped in pairs.

18. Gauge: Gauges and tape used shall be M. C. B. standard as follows:

M. C. B. standard wheel circumference measure, sheet 16-A.
Maximum flange thickness gauge, exhibit H.
Minimum flange thickness gauge, exhibit I.
M. C. B. recommended rotundity gauge, exhibit J.
M. C. B. recommended plane gauge, exhibit K.
M. C. B. recommended gauge for measuring service metal, exhibit L.

19. Branding: Wheels shall be stamped with date, heat number, maker's serial number and brand, also purchaser's name and serial number, if specified. The branding is to be done according to M. C. B. recommended practice, exhibit O.

20. Inspection: The inspector representing the purchaser shall have free entry at all times, while his contract is being executed, to all portions of the manufacturer's plant. All reasonable facilities and necessary gauges shall be afforded the inspector by the manufacturer to satisfy him that the wheels are being furnished in accordance with the specifications. All tests and inspection shall be made at the place of manufacture prior to shipment and free of cost to the purchaser. The purchaser shall have the right to make tests to govern the acceptance or rejection in their own test room or elsewhere as may be decided by the purchaser.



MASTER CAR BUILDERS ASSOCIATION
RECOMMENDED PRACTICE
ROTUNDITY GAUGE
FOR 33" OR 36" SOLID STEEL WHEELS
RECOMMENDED, 1912.
EXHIBIT- J.

Samples of rejected material must be preserved at the laboratory of the purchaser for one month from date of test report. In case of dissatisfaction with the results of the tests, the manufacturer must make claim for a rehearing (should he desire to do so) within that time. Tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the mill.

Recommendation No. 2.

It is recommended that the size and dimensions for solid steel wheels for freight and passenger cars be adopted as shown on the following drawings:

33-inch solid steel wheels for 4¼ by 8, 5 by 9, and 5½ by 10 inch axle, exhibit A.

33-inch solid steel wheels for 6 by 11 inch axle, exhibit B.

36-inch solid steel wheels for 4¼ by 8, 5 by 9, and 5½ by 10 inch axle, exhibit C.

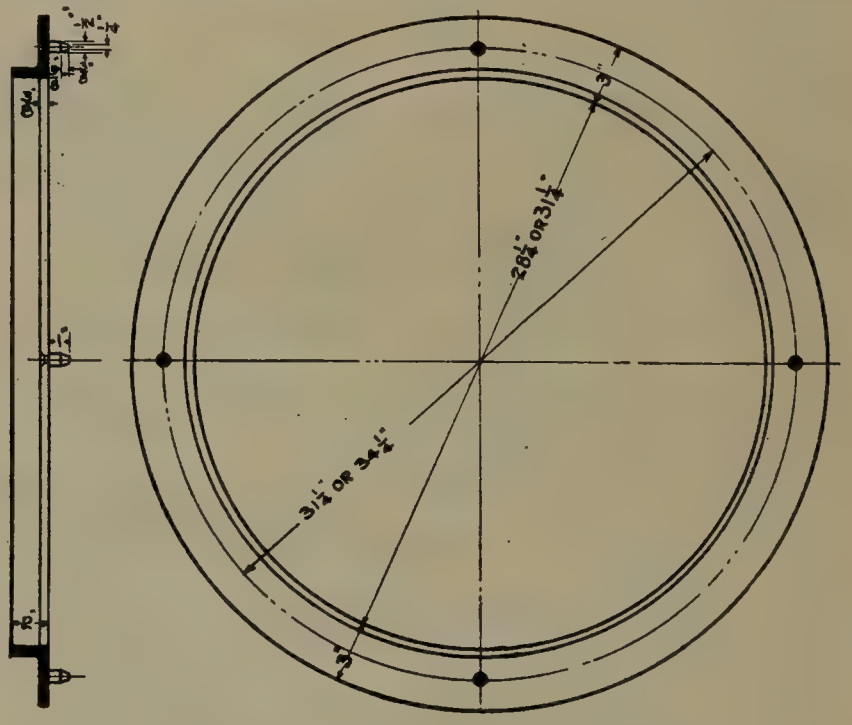
36-inch solid steel wheels for 6 by 11 inch axle, exhibit D.

Recommendation No. 3.

It is recommended that the thickness of flange for steel and steel-tired wheels be increased $\frac{3}{32}$ inch, making the contour to the base line same as the cast-iron wheels, as shown on exhibit G, herewith attached, and it is recommended that this cut be shown as Fig. 5 on sheet "C," M. C. B. recommended practice, in place of the present cut.

Recommendation No. 4.

As it is found desirable to have a gauge for measuring the thickness and height of flanges as well as throat radius of steel wheels,



MASTER CAR BUILDERS ASSOCIATION
RECOMMENDED PRACTICE
PLANE GAUGE
FOR SOLID STEEL WHEELS.
RECOMMENDED, 1912.
EXHIBIT—K.

it is recommended that the present maximum and minimum flange thickness gauge shown on M. C. B. sheet 16 be changed and made similar to the cut shown on exhibits H and I. This will give a maximum and minimum flange thickness gauge same for either cast-iron, solid steel and steel-tired wheels, and also a maximum and minimum height and throat radius for steel wheels.

Recommendation No. 5.

It is recommended that a rotundity gauge be adopted for the purpose of measuring the maximum distance that wheels are out of round, as shown on exhibit J.

Recommendation No. 6.

It is recommended that a plane gauge for the purpose of measuring how much wheels are cut of plane be adopted, as shown on exhibit K.

Recommendation No. 7.

It is recommended that a gauge be adopted for the purpose of measuring the thickness of the rim above the limit of wear groove, as shown on exhibit L. With this gauge it is possible to measure direct the amount of metal necessary to remove to restore the tread to M. C. B. contour. It is also possible to measure direct the amount of service metal remaining above the condemning limit after the tread is restored to M. C. B. contour.

Recommendation No. 8.

It is recommended that a standard fastening for all steel-tired wheels be adopted, as shown on exhibit N.

Recommendation No. 9.

It is recommended that a standard method of branding all steel wheels be adopted, as shown on exhibit O.

The following changes in the present specifications for cast-iron wheels are recommended:

Recommendation No. 10.

The sixth clause under paragraph No. 4 reads as follows:

"Should the test wheel stand the given number of blows without breaking in two or more pieces, the inspector will then subject the other wheel to the following test":

It is recommended that this sentence be changed to the following:

"Should the test wheel stand the given number of blows without breaking in two or more pieces, the drop test will be satisfied and the inspector will then subject the other wheel to the following test":

Recommendation No. 11.

The last sentence in the seventh clause of paragraph No. 4 now reads as follows:

"If the wheel is found broken in pieces, or if any crack in the plate extends through or into the tread, the 100 wheels represented by the test will be rejected."

It is recommended that this sentence be changed to the following:

"If the wheel is found broken in pieces, or if any crack in the plate extends through or into the tread, all wheels of the same tape size as the broken wheel will be rejected."

Recommendation No. 12.

Paragraph 9, of the present specification, reads as follows:

"Individual wheels will not be accepted which:

"(1) Do not conform to standard design and measurements.

"(2) Are under minimum weight. All excess weight over the maximum to be given at the expense of the manufacturer.

"(3) Have physical defects described in section 2. Any lot of one hundred wheels submitted to test will not be accepted.

"(1) If wheels broken do not meet the prescribed drop test.

"(2) If the wheel tested does not stand the thermal tests.

"(3) If the conditions prescribed in section 3 are not complied with."

It is recommended that this paragraph No. 9 be changed to the following:

"Individual wheels will not be accepted which:

"(1) Do not conform to standard design and measurements.

"(2) Are under minimum weight.

"(3) Have physical defects described in section 2.

"If in any lot of 100 wheels submitted to test, the test wheel fails to meet the requirements of the drop, chill, or thermal test, then all of the wheels in tape number and weight corresponding to the test wheel will be rejected. In case the rejection is for high chill, weak breaking strength, or failure in the thermal test, the test will be continued in the next higher number of tape size, or if the rejection is for low chill, the test will be continued in the next lower number tape size.

"In any shipment where the average weight of wheels is above the maximum weight of wheels the excess weight to be at the expense of the manufacturer.

"In case wheels ordered with cores smaller in diameter than the standard, the additional weight should be considered as an addition to the normal weight and paid for by the purchaser."

Recommendation No. 13.

It is recommended that the letters AB be added to the measuring line 2⅝ inches from the outside rim of the wheel to the drawing of the 625-pound cast-iron wheel M. C. B. sheet "N," of the 675-pound cast-iron wheel M. C. B. sheet "O," and the 725-pound cast-iron wheel M. C. B. sheet "P."

Recommendation No. 14.

It is recommended that the following clause be added to the code of rules of the interchange of traffic:

"Rule 76A. Height of flange: If the height of flange is 1½ inches or greater."

Recommendation No. 15.

It is recommended that the standard size of cores for cast-iron wheels be shown on the drawings of same as follows:

M. C. B. sheet "M" recommended practice, for cast-iron wheels for 60,000-pound cars. Add the following clause:

"Standard core 5¼ inches diameter."

M. C. B. sheet "O" recommended practice, for cast-iron wheels for 80,000-pound cars. Add the following clause:

"Standard core 6 inches in diameter."

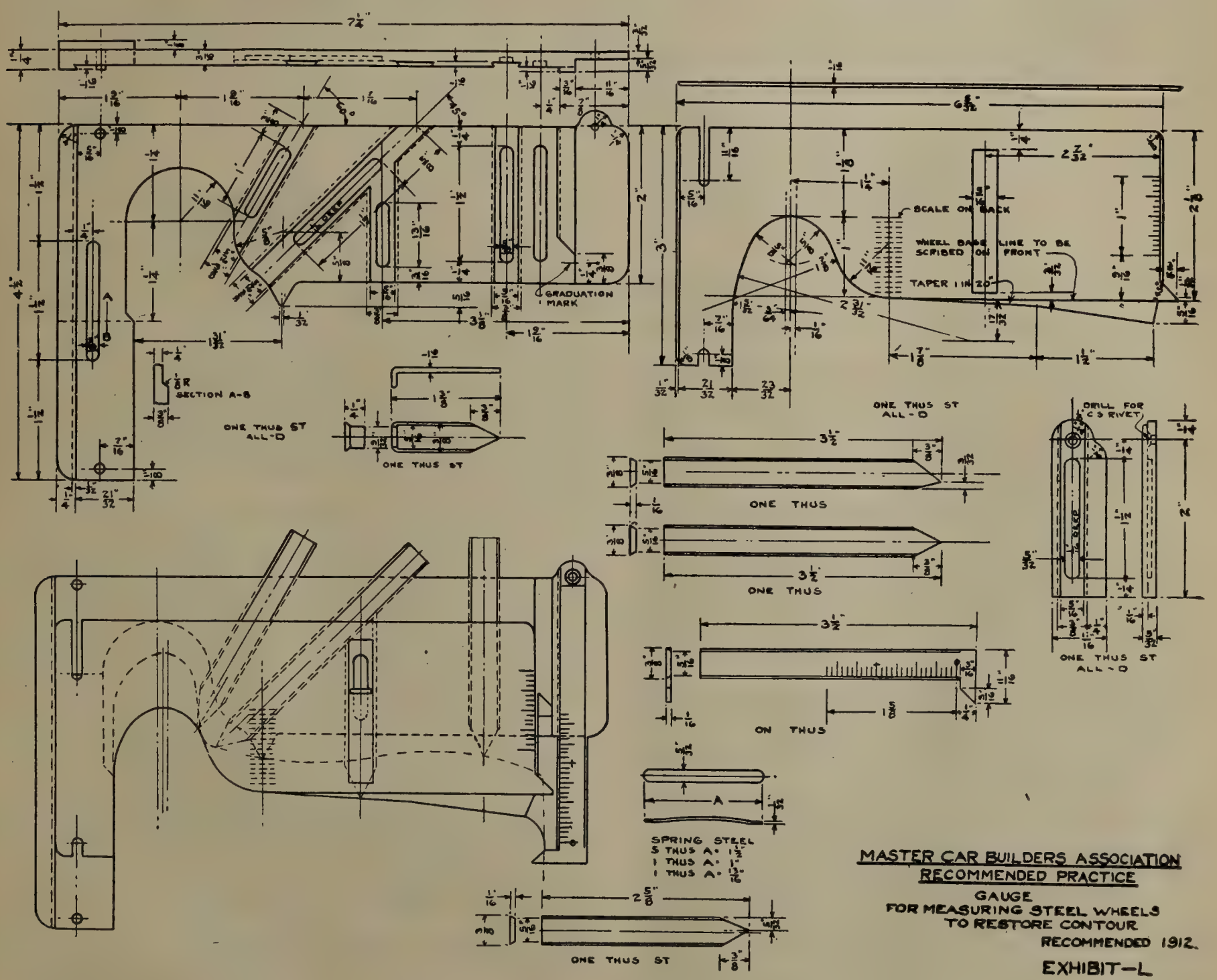
M. C. B. sheet "P" recommended practice, for cast-iron wheels for 100,000-pound cars. Add the following clause:

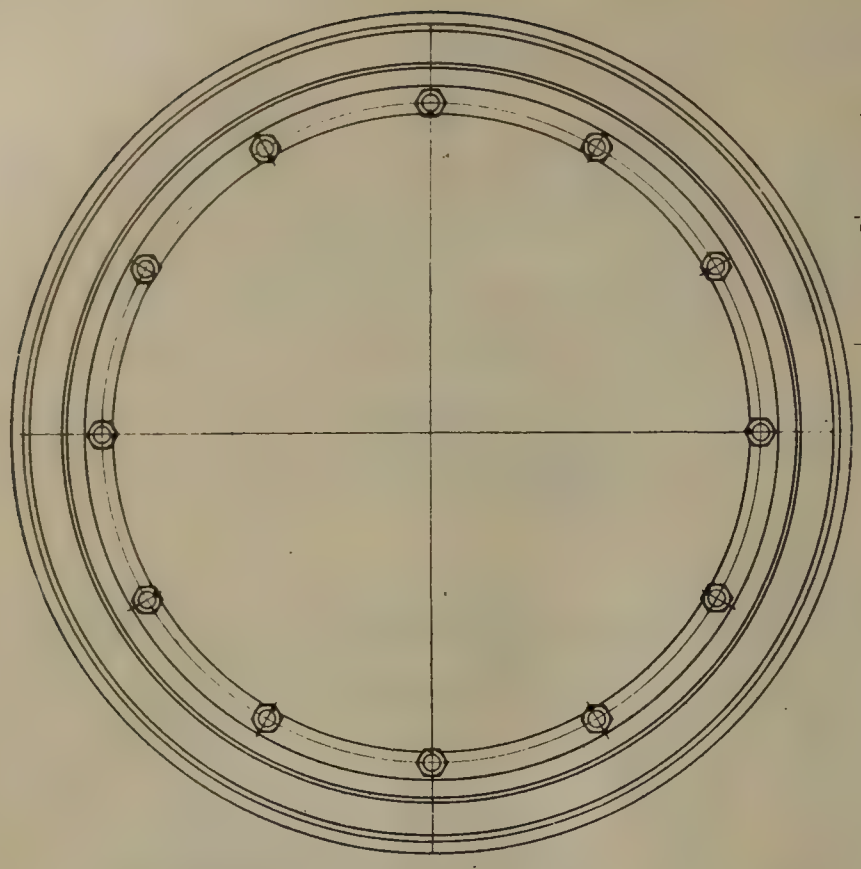
"Standard core 6½ inches in diameter."

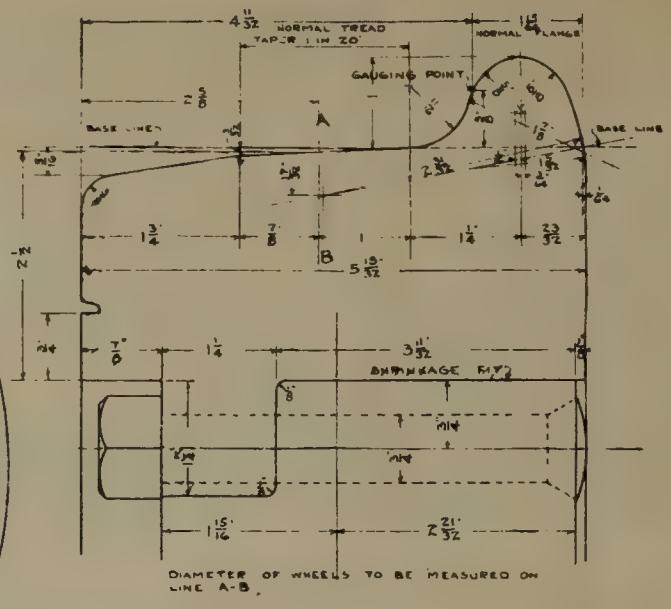
The above notations to be placed under the dimensions of the finished bore.

(Signed) Wm. Garstang.
W. C. A. Henry.
A. E. Manchester.
R. W. Burnett.
R. L. Ettenger.
O. C. Cromwell.
J. A. Pilcher.

After reading the printed paper, Mr. Garstang said that since the report was written, they had found that some roads were using a 38-inch diameter wheel in passenger service, while the committee recommended 33-inch and 36-inch wheels. In view of this fact,







MASTER CAR BUILDERS ASSOCIATION
RECOMMENDED PRACTICE
PROPOSED TIRE FASTENING FOR STEEL TIRED WHEELS
RECOMMENDED 1912
EXHIBIT- N

and with the consent of the association, the wheel committee wished to include the 38-inch wheel and submit drawings.

There being no objection the committee was asked to submit these drawings.

Discussion.

Henry La Rue: I would like to see a drawing made of the lettering on the wheel mentioned in recommendation No. 9. Some countersink it, some put fancy frills on it, and I believe we should have a standard lettering for it.

Mr. Garstang stated that this would be included.

J. J. Hennessey: I believe the association should extend a vote of thanks for this very complete report, and I move that it be received and referred to letter ballot.

C. D. Young: With reference to the figure showing proposed tire. This dimension is ⅛ inch and if drilling is not carefully done we find that fractures have started at the bolt hole because of the lack of metal between the bolt hole and the inner circle of the tire. This dimension is ⅛ inch and if drilling is not carefully done it will be decreased. I believe that the over-all dimension at this point should be increased from 1¼ inches to 1⅜ inches.

I. S. Downing: We had the same experience as Mr. Young and had one serious wreck because these holes were bored too close to the inner walls of the tire.

Wm. Garstang: In this design there is a large amount of flat-bearing surface and the tire depends on the shrinkage. The bolt is simply to hold the tire in case of breakage. I do not see what benefit will be derived by increasing this distance.

Henry La Rue: Has there been any trouble with regard to the dropping of the contour of the throat of the wheel from ¼ inch to $\frac{5}{16}$ inch on the outside?

D. E. Fitzgerald: The change in contour has caused two wrecks on our lines. If the rails are a little wide in gauge, the sharp contour tends to form a wedging motion which causes the flange on the other side to climb the rail.

L. C. Ord: Are the fractures to which Mr. Young refers important? What results has he had to make it worth while to add metal at this point? It is a proposition of the relative value of that extra metal. I don't see how these fractures could occur unless the tire was loose and improperly secured at the center.

C. D. Young: The bolt is a driving fit and as there is not much to resist it, it tends to spread the metal.

Wm. Garstang: Personally I don't think it would make any difference if it was only $\frac{1}{16}$ inch thick at this point.

Mr. Hennessey's motion that the report be received and referred to letter ballot was carried.

THURSDAY, JUNE 13.

SAFETY APPLIANCES.

President Stewart as chairman of the Committee on Safety Appliances made the following report:

The committee has no formal report to make. The work of the committee in conjunction with the federal authorities last year covered the entire case. We are making some recommendation to the executive committee, particularly with regard to rules to be adopted for handling foreign cars which have to be rebuilt or repaired. Also foreign cars shipped for ordinary repairs and not equipped with U. S. safety appliances, and foreign cars marked "U. S. Safety Appliances, but improperly equipped." The committee has had a meeting with the chief inspector of the Interstate Commerce Commission with regard to a uniform understanding. We found that the chief inspector had done much along this line. The committee will in the future endeavor to straighten out matters not thoroughly understood, and as it is a standing committee, suggestions and questions from any member would be welcomed.

REVISION OF RULES OF INTERCHANGE.

The members and various railway clubs and organizations in the rules of interchange were asked to submit what changes were considered desirable. These have been considered and the recommendations of the committee are given under each rule. Several suggestions were received in regard to changes in Rules 98, 101, 102, 107, 116 and 117, covering the matter of changes in prices for labor and materials. These have been referred to the committee on that subject.

Rule 2.—The committee would suggest that this rule be changed to read as follows:

"Cars (whether loaded or empty) with defects constituting a violation of the law must not be offered in interchange. The unnecessary movement of leaking tank cars loaded with inflammable materials is in violation of the law. Such cars should be repaired or have lading transferred at the nearest available point. Cars having defects for which delivering company is responsible must be properly carded when offered in interchange. Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge in cases not provided for in Rules 3 and 4 and 32 to 88, inclusive.

"Owners must receive their own cars when offered home, subject to the provisions of these rules. Loaded cars offered in interchange, except those having defects constituting a violation of the law, must be accepted. The reciving line may also reject cars not loaded in accordance with the rules for loading materials, A. R. A. car service Rule 15 to apply (see page 22) when transfer or rearrangement of load is necessary. The car transfer check authorizing the transfer or rearrangement of lading to be of the form shown herewith. Balance of rule to remain as at present.

"The form shown above to be modified by the addition of the words 'or lading adjusted.' "

Rule 8.—The committee would suggest that for the words "tacked on" in the fifth line the words "securely attached to," be substituted.

Rule 9.—The following suggestions are approved:

Change the rule to read:

M. C. B. Couplers, or Parts Thereof, R. and R.
New or second-hand.
Steel or malleable.
Size of shank.
Size of butt.
Complete, or name of part or parts.
Name of coupler.
Open or solid knuckle.
Yoke, stem or key attachment.

Wheels and Axles, R. and R.
Cast iron, cast steel, rolled or forged steel or steel-tired wheels.
New or second-hand.
Cause of removal (see Rule 10).
Trucks: solid pedestal or arch bar type.
Journal Bearings, R. and R.
Solid, filled or other kind.
Length of bearings.

Box number (see Rule 14).

Metal Brake Beams, or Parts Thereof, R. and R.
Make or name of beam.
New or second-hand.
Complete, or part or parts.
Cause of renewal.
Parts or parts scrapped.

Brake Shoes, Applied—Triple Valve, R. and R.
Cast or reinforced back.
Name of maker and type.

When triple valve or cylinder is cleaned, the initial of road and

date of last previous cleaning must be shown. If necessary to remove load to make repairs, as specified in Rule 107, it must be plainly stated.

Rule 10.—The committee recommends that all of the first paragraph after the word "used" in the third line be omitted.

Rule 11.—The committee recommends making the rule clearer as follows: "Journal bearings having a babbit lining ⅜ in. thick or thicker, shall be charged as filled journal bearings and not as solid journal bearings."

Rule 12.—The committee would propose the following additional paragraph: "If an intermediate line finds it necessary for safety to standardize wrong repairs, it may render bill against the car owner for the expense, and the billing repair card of such intermediate line shall be final as to the facts that such wrong repairs existed, and shall perform the same function as a joint evidence card. If the car carries repair card covering such wrong repairs, such repair card must accompany bill against the car owner. If such repair card covers items other than those corrected, the items corrected must be crossed off and the card replaced on car, but a copy of such repair card must accompany the bill against the car owner."

Rule 14.—The committee proposes that the first part of the rule read: "Defect and repair cards (and joint evidence cards, as per Rule 12) must be securely attached to car," etc.

Rule 18.—The committee would suggest that this rule be modified as follows:

1. "Couplers that exceed the distance of 5⅛ in. between point of knuckle and guard arm measured perpendicularly to guard arm, must have the defective part or parts renewed to bring coupler within gage, in which case owners are responsible. (See drawing, page 11.)

2. "Cars having couplers with stem or spindle attachments or American continuous draft rods will not be accepted in interchange after September 1, 1914."

Rule 20.—The committee recommends that the rule be changed to read: "Cars must be maintained within the limits of standard height for couplers, measured from the top of the rails to the center of coupler head. Any company finding cars not within the limits of standard height for couplers may repair and charge to owners. As far as possible, cars should be adjusted when empty.

"Empty cars measuring 32½ in. or less shall be adjusted to 34½ in., or as near as practicable thereto, but not exceeding 34½ in. Loaded cars measuring 31½ in. or less shall be adjusted to 33½ in., or as near as practicable thereto, but not exceeding 33½ in. When bill is to be rendered, the height of car before and after altering must be shown on repair cards."

Rule 21.—The committee suggests changing the rule to read: "Bills may be rendered against car owners for the cost of applying temporary running boards and hand rails to cars originally equipped with roofs or running boards to make such cars safe for trainmen."

Rule 24.—The committee suggests the omission of the word "new" in the first line of the second paragraph, as this provision should apply equally to second-hand wheels.

Rule 33.—The committee approves of the addition of "hatch covers" and "vent slides" to the exceptions in this rule.

Rule 34.—The committee approves the omission of this rule.

Rule 35.—The committee would recommend that the rule be changed to read: "After September 1, 1914, cars equipped with couplers having stem or spindle attachments, or American continuous draft rods, will not be accepted in interchange."

Rule 36.—The committee suggests that this rule be eliminated.

The committee would recommend that the heading to combinations (Rules 37 to 42, inclusive) be changed by the addition of the words, "and requiring repairs or renewals."

Rule 40.—The committee proposes that the rule read as follows: "Damaged end sill, accompanied by damage to two longitudinal sills."

Rule 42.—The committee approves changing the rule to read: "Damaged corner and end posts, if necessitating the renewal of more than three posts," and would suggest the following note: "Damage as used in the above combinations is understood to mean injury so serious as to render renewal or repairs necessary to the part or parts mentioned."

Rule 48.—The committee would recommend the rule be changed to read: "Side doors, end doors, roof doors, grain doors, water troughs and attachments and all inside parts or all concealed parts of cars missing or damaged under fair usage," etc.

Rule 50.—The committee would recommend the addition of the words "as provided for in rule 20" to make reference to the provision in this rule.

Rule 52.—The committee would suggest the following change in the fourth paragraph of this rule: "On cars stenciled 'United States Safety Appliances Standard,' or on cars stenciled 'United States Safety Appliances,' lag screws must not be used where bolts or rivets are required by law." Also the omission of the bracket from this paragraph of the rule.

Rule 5.—The committee suggests making the rule read: "All freight cars offered in interchange must be equipped with air brakes, angle cocks, quick-action triple valves, M. C. B. standard 1¼-in. train line and pressure retaining valves."

Rule 54.—The committee approves the suggestion of adding to this rule the words, "that require repairs or renewals."

Rule 56.—The committee approves the suggestion to eliminate this rule.

Rule 59.—The committee suggests the elimination of reference to Rule 56, on account of the suggestion that it be omitted. Also suggests including "broken brake pipes and cross-over pipes due to insecure fastenings" after the words "rust or seams" in third line.

M. C. B. ASSOCIATION—AUTHORITY FOR TRANSFER OR ADJUSTMENT OF LADING.

Send bill and this check card to

(NAME OF ROAD)

Date.....

Lading .....

Transferred or Lading Adjusted. Account of.....

.....

.....

Issued to..... R. R.....

Car No..... Initial.....

Inspector at.....

NOTE.—To be printed in black on white paper in duplicate form, filled out with ink or black indelible pencil. Original to accompany bill and duplicate retained for record.

Car Transfer Check.

Rule 60.—The committee approves the changing of the last paragraph to read: "Triple valves cleaned must be tested in accordance with the M. C. B. code of tests for repaired triple valves."

Rule 62.—The committee approves changing this rule to read: "Damage of any kind to truck due to unfair usage, derailment or accident that requires renewal or repairs."

Rule 66.—The committee would recommend that the second paragraph of this rule be changed to read: "After September 1, 1915, cars equipped with brake beams other than all metal will not be accepted in interchange."

Rule 69.—The committee approves the omission of the words "or if it extends ⅛ in. past the center of flange."

Rule 70.—The committee approves the suggestion that the words "or steel tired" be omitted from the third paragraph.

Rule 82.—The committee approves eliminating the last two lines of this rule.

Rule 101.—To conform to the provisions in the proposed change in Rule 20 the committee would recommend the following change in prices:

Altering height of one end of car, over or under center plates or on top of body bolster, net.....$1.25

Altering height of one end of car, shimming springs, net..... .75

Rule 107.—The committee would recommend the addition of the following item:

Draft timber bolts, tightening up, on one end of car, ½ hour..$0.12

Rule 108.—The committee suggests that the second paragraph read as follows: "No charge to be made for adjusting brakes, angle cocks or tightening unions."

Rule 110.—The committee suggests this rule be changed to read: "Applying center plate or center plate bolts when car is raised to standard height adjusting center plates or body bolster, at same end of car."

Rule 115.—The committee would recommend that the word "nearest" in the eighth line of first paragraph be changed to "designated." Also change second paragraph to read: "Except in cases of trucks of 50,000 lbs. capacity or less, where the railway company destroying the body of car may elect to retain the trucks and settle for them at their scrap value, except that such of the wheels, axles or all metal brake beams as are good for further service, must be credited at their second-hand value under the M. C. B. rules. This paragraph will not apply to trucks belonging to individual ownership."

Also an additional paragraph reading: "The underframes of damaged steel and steel underframe cars when intact and in serviceable condition may be forwarded to owner on defect card."

Rule 122.—The committee would recommend the following change in this rule: "Companies shall promptly furnish to each other, upon requisition, and forward, freight charges F. O. B. point of shipment, material for repairs of their cars damaged upon foreign lines," etc., balance of rule to remain as at present.

Rule 123.—It has been suggested that rule state which party to dispute shall prepare abstract. In case of any dispute or question arising under the rules between the subscribers to said rules, the same may be submitted to this committee, through the secretary, in abstract, to be signed by both parties to the dispute, to receive consideration by the arbitration committee. The abstract should set forth: An agreed statement of facts; argument of plaintiff and argument of defendant.

The abstract should consist of not more than three typewritten pages, letter size, single space, and should be signed by both parties to the dispute. Balance of rule to remain as at present.

Rule 131.—This code of rules shall take effect September 1, 1912.

Page 105. Rule 2. Item (C).—Under item C, Rule 2, of the passenger car code of rules, page 105, the committee would suggest the addition of "shades" and "belts" under the heading of electric lighting, believing these two items should be included in line expenses proratable.

The Secretary: In accordance with the request of the arbitration committee, a meeting was held June 13, at which time a large proportion of the members of the association in attendance at this convention were present. The object of the meeting was to consider the report of the arbitration committee in reference to proposed changes in the rules of interchange. As a result the arbitration committee would recommend the following changes in its recommendations:

Rule 2.—Cars having defects for which the delivering company is responsible must be properly carded when offered in interchange. Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge in cases not provided for in Rules 3 and 4, and 32 to 88, inclusive. Owners must receive their own cars when offered home for re-

pairs, subject to the provisions of these rules. Loaded cars offered in interchange must be accepted, with the following exceptions:

(a) Cars (whether loaded or empty) having defects in violation of the Safety Appliance Acts, must not be offered in interchange.

(b) Leaking tank cars containing inflammable liquid must be repaired or transferred without any unnecessary movement or at nearest available point with least possible risk. Also, cars loaded with explosives shall be handled in accordance with the regulations of the Interstate Commerce Commission.

(c) Cars improperly loaded, when not complying with the rules for loading material.

(d) Lading of open cars when dimensions of lading are in excess of published clearances of roads over which the shipment is destined.

(e) When cars cannot pass approved third rail clearances of American Railway Association.

American Railway Association car service rule 15 to apply (see page 83) when transfer or rearrangement of lading is necessary.

The car transfer check authorizing transfer or rearrangement of lading to be of the form shown under rule 2 of the report.

When the lading is transferred by the receiving line the car, when empty, may be returned to the delivering line.

(Last paragraph as at present.)

Also, that American Railway Association rule 15, as shown on page 88 of the rules of interchange, be changed to conform to the rule as amended by that association, reading as follows:

Rule 15. Unless otherwise agreed, the cost of transferring the lading of freight cars or rearrangement of lading at junction points shall be settled as follows:

First—The delivering road shall pay cost of transfer or rearrangement.

(a) When transfer is due to defective equipment that is not safe to run according to M. C. B. rules.

(b) When transfer or rearrangement of load is due to contents being improperly loaded or overloaded according to M. C. B. rules or the Interstate Commerce Commission regulations for the transportation of explosives and other dangerous articles by freight and by express, or when dimensions of the lading of open cars are in excess of the published clearances of any of the roads covered by the routing.

(c) When transfer is due to delivering line not desiring its equipment to go beyond junction points.

(d) When cars cannot pass approved third rail clearances of the American Railway Association.

Second—The receiving road shall pay cost of transfer or rearrangement:

(e) When cars cannot pass clearances, except as provided in paragraph (d) or when cars and lading exceed the load limit or cannot be moved through on account of any other disability of the receiving line. (Note—The word "cars" covers both closed and open cars, but not lading on open cars. The words "load limit" refer to the limits placed on bridges, tracks, etc., and not to car capacity.)

(f) When the receiving road desires transfer to save cost of mileage or per diem.

Rule 20.—As agreed, the committee would change the word "head" to "shank" in the third line of the first paragraph of its recommendation to conform to the terms employed by the Interstate Commerce Inspectors.

Rule 30.—Inasmuch as weighing associations do not now stencil the new light weight on the car, the committee will suggest to the executive committee that the matter should be preferably referred to the American Railway Association from this association, so that any weighing bureau or association light weighing cars shall, in addition, properly restencil the new light weight on the car. In the meantime the present rule should remain as it now reads.

Rule 64.—The committee would suggest that the words "and nuts" in last line of the rule be omitted.

Rule 91.—The committee will refer the proposed changes in this rule to the executive committee, with the request that it will confer with the accounting officers, association, and advise whether they would concur in the proposed changes in the rule leaving the rule as it now stands.

Rule 98.—The committee would suggest that in the last line the dimension $\frac{1}{16}$ in. be changed to $\frac{1}{8}$ in.

Rule 102.—The committee would suggest that the last sentence in this rule be changed to read:

No charge to be made for lettering, except when done to preserve the identity of the car and not necessitated by other repairs.

Rule 110.—The committee finds that the word "by" has been omitted between the words "height" and "adjusting" in the second line of its recommendations, and suggests that it be placed there.

The question was raised as to the proper height of passenger car couplers. The committee will refer this to the executive committee for decision.

Jos. W. Taylor, Secretary.

Discussion.

F. W. Brazier: I move that the report as amended be accepted.

This motion was carried and a vote of thanks was given the committee for its excellent work. The decisions of the committee were also approved.

PRICES FOR LABOR AND MATERIAL.

The committee recommends no action on rule No. 116; committee not being certain that they have authority to take this matter up, though mentioned in circular of inquiry, and very few suggestions as to changes were received. It may be desirable when the revision of these prices is undertaken to base them upon the classification of cars, now included as recommended practice.

The entire subject of prices for labor and material on passenger equipment is not reported upon for the reason that very few railroads made suggestions in regard to changes, and on account of the many changes now taking place in the construction of passenger equipment we were unable to give this subject the necessary attention, and recommend it be given further consideration.

The committee has, however, accepted the recommendations of chairman of Master Car Builders' train lighting committee, which are embodied in report herewith.

If new wheels and axles are substituted for second-hand wheels and axles, proper charges and credits shall be allowed, although such substitutions be made on account of only one loose or defective wheel or a defective axle with the following exceptions: In case the owner of a car removes a damaged wheel or axle, no charge shall be made for any difference in value between the parts used and those removed that are not damaged.

Removing, turning and replacing a pair of forged steel or steel-tired wheels, $3.25 for pedestal type of truck and $3 for arch bar truck.

It is recommended that this paragraph be changed to read:

"Labor turning per pair forged steel or steel-tired wheels, $1.25.

"The price for new forged or rolled steel wheels shall only apply to such wheels having treads 1⅜ inches thick or over, measured from base line of tread to the condemning limit, which is ¼ inch above witness groove. For wheels having treads less than 1⅜ inches thick as described, a reduction shall be made in price at the rate of 75 cents per $\frac{1}{16}$ inch thickness (on radius) of tread.

"Any loss or increase of service metal on forged or rolled steel wheels shall be credited or charged at the rate of 75 cents per $\frac{1}{16}$ inch thickness (on radius) of tread."

Delivering Line Defects.

When repairs are not covered by a defect card, the proper credit for any loss of service metal must be given the owner; but no charge shall be made against the owner for any increase in the amount of service metal, due to application of other wheels.

Delivering Line Defects.

When the repairs are covered by the defect card of another company, charge covering such repairs shall be made against the owner of the car, the defect card and the billing repair card to be attached to the bill. The owner to render counter-bill on the authority of the defect card against the company issuing same, including an additional charge to cover the loss of service metal, on account of the defects covered by the card. Should there be an additional loss of service metal, on account of the application of other wheels, the company making the repairs shall allow the proper credit to the owner to cover such additional loss of metal. Should there be an increase in the amount of service metal, due to the application of other wheels, such increase may be charged to the owner and included in the owner's counter-bill against the company issuing the defect card, except when repairs are made by the owner.

It is recommended that this paragraph be changed to read:

"When the repairs are covered by the defect card of another company, charge covering such repairs shall be made against the owner of the car, the defect card and the billing repair card to be attached to the bill. The owner to render counter-bill on the authority of the defect card against the company issuing same, including an additional charge to cover the loss of service metal, on account of the defects covered by the card. Should there be an additional loss of service metal, on account of the application of other wheels, the company making the repairs shall allow the proper credit to the owner to cover such additional loss of service metal. Should there be an increase in the amount of service metal, due to the application of other wheels, such increase may be charged to the owner."

The above provisions shall govern any loss or increase of service metal on account of the mate wheel, even if same is not defective, when both wheels are turned off to correspond.

The necessary information must be given in all cases, as provided in rule 10.

In cases of slid-flat wheels, $\frac{1}{16}$ inch for loss of service metal will be allowed for flat spots 2½ inches long and $\frac{1}{16}$ inch for each additional inch or fraction thereof.

It is recommended that this paragraph be changed to read:

"In case of slid-flat wheels, 2-16 inch for loss of service metal will be allowed for flat spots 2½ inches long and $\frac{1}{16}$ inch for each additional inch or fraction thereof."

Page 108, rule 12, last paragraph, should read:

"On electrically lighted cars equipped with storage batteries or axle device, furnished to foreign roads, where no agreement is made, a charge of 75 cents per car per day shall be made for the use of the electrical equipment."

(Signed) F. H. Clark.
G. E. Carson.
C. F. Thiele.
Ira Everett.
B. Julien.
S. T. Park.
H. E. Passmore,

Discussion.

J. J. Hennessey: I move that the recommendation of the committee be accepted.

A. W. Gibbs: The tank car committee has a recommendation as to the price of safety valves and if the committee approves, would like to have these prices included.

F. H. Clark: The committee will be glad to receive and consider these prices.

J. J. Tatum: Due to some changes made by the arbitration committee, it has been found necessary to add this item to rule 101: "Stenciling on the sides and ends when done to preserve identity of car and not necessitated by other repairs, net price 50 cents."

Mr. Hennessey's motion was carried.

RULES FOR LOADING MATERIALS.

The committee wishes to report the following recommendations for changes in the present code of rules for loading materials. The modifications, in the main, have reference to reductions in amount of material required to build up loads, having due regard for the safety of cars as well as lading in transit. We have during the past year collected a good deal of information from railroads and shippers in connection with the several suggestions we are recommending, some of this information coming to us quite recently.

First we would direct attention to rule No. 6, and with particular reference to its apparent conflict with American Railway Association rule No. 15, some allusion to which was made in our report of 1910. Your committee has had a great deal of correspondence during the past year concerning this particular subject, no doubt mainly brought about by the insertion of the second paragraph of rule No. 6, which was effected in 1911 on the strength of an interpretation given us by the American Railway Association.

In our 1910 report we stated that the question concerning the apparent conflict between M. C. B. rule No. 6 for loading materials and American Railway Association rule No. 15 was first brought up by Mr. Delano, then president of the American Railway Association, he suggesting some modification in the rule to make it harmonize with rule 15 of the American Railway Association. In a letter Mr. Delano wrote Mr. Clark, then president of the Master Car Builders' Association, it was suggested that rule No. 6 of the rules for loading materials be modified to conform to the principle of Run, Repair or Transfer, in order to increase the movement of cars in interchange. The specific point in rule No. 6 was its apparent conflict with paragraph "D" of American Railway Association rule 15, showing the conditions for which the receiving road should pay cost of transfer, the paragraph reading as follows:

"The receiving road shall pay cost of transfer or rearrangement: (d) When cars exceed load limit or cannot pass clearances or be moved through on account of any other disability of receiving line."

After the presentation of the 1911 report your committee recommended to the arbitration committee the acceptance of the last suggestion offered by the American Railway Association, which was to add the following paragraph to rule No. 6:

"Should it become necessary to transfer or rearrange the lading in transit on account of excess width or height of lading, see American Railway Association Car Service rule No. 15, paragraph "D."

This was done under the impression that the supplement would remove the apparent conflict, still leaving rule No. 6 in such shape as to allow the shippers to build up loads within reasonable limits, without infringing upon the principle involved in American Railway Association rule 15.

The application of the second paragraph or added portion of rule No. 6 soon demonstrated the wisdom of the rule as it originally stood prior to the change last year, which required that the load be built up with reference to the clearances of the roads over which the lading is routed. In the light of this development the General Managers' Association, of New York, at their meeting held in New York, December, 1911, concluded to suggest to the American Railway Association certain modifications to American Railway Association rule 15, having further in mind that in the event of the American Railway Association adopting such changes the Master Car Builders should be requested to modify rule No. 6 for loading materials, erasing therefrom that portion of the rule which was added in 1911, which would leave the rule practically in its original shape. Your committee has no further reference to make relative to rule No. 6 until the matter is disposed of by the American Railway Association.

Rule No. 10.—Wooden cars of light capacity when used as idlers between cars of heavier capacity are liable to break down when placed in a train composed of heavier capacity cars, in case of sudden stops or emergency application of the brakes; a paragraph, therefore, should be added to rule No. 10 reading as follows:

"If the idler is a flat car of wooden construction, its capacity must be not less than that of the carrying cars."

Rule No. 11.—Change the word "for" to "from" following the word "inches" in the middle line of the last paragraph of this rule, which would make the last paragraph read as follows:

"For loads of greater height than 12 feet, subtract two inches from given width (w) of load for every inch of height in excess of 12 feet."

Rule No. 23.—The first sentence of this rule should be changed to read as follows, so as to also cover the placing of sliding as well as bearing pieces:

"Bearing and sliding pieces must never be placed between bolster and end of car, unless special provision is made therefor in detail instructions."

Rule No. 43.—This rule should be changed to read as follows:

"The lading overhanging the idler, Figs. 6 and 7, must be governed by restrictions contained in general rule No. 11 so that overhang will not exceed clearances in curving."

Rule No. 45.—The last portion of this rule should be changed to read as follows:

"Where the pile of lumber on the idler exceeds 20 feet in length, four (4) stakes on each side must be used, three (3) on each side being sufficient for shorter piles to conform to rule No. 34."

This would make the new rule read as follows:

"The five stakes on each side of the carrying car should be placed as near the bolsters as possible, and no stakes whatever should be used on the idler to confine the overhanging part. The only stakes permitted on the idler will be such as may be required for the short lumber loaded on the idler. Where the pile of lumber on the idler exceeds 20 feet in length, four (4) stakes on each side must be used, three (3) on each side being sufficient for shorter piles to conform to rule No. 34. All stakes should be fastened as shown in Figs. 6 and 7, and as provided for in rules 12, 13, 34, 35 and 36."

Rule No. 55.—We find that some of the Canadian roads have flat cars equipped with permanent chains and short stakes, which are used for the handling of logs, and having ascertained that logs loaded on these cars with this method of binding the lading are safe, we would recommend the addition of the following note immediately after rule No. 55 so as to allow the use of this equipment for handling the material in question. It would be proper to mention that this subject came up last year, too late to be presented in our report. The subject was put before the executive committee, but was laid on the table.

"Logs loaded in accordance with Fig. 14 secured by means of permanent short stakes and chains in lieu of the specified staking and wiring will be acceptable."

Rules 56 and 57.—These two rules should refer to flat as well as low-sided gondola cars and, therefore, should be changed to read as follows:

"Rule No. 56.—When material of this kind is loaded on flat or gondola cars with sides less than 30 inches high, and lading does not exceed 4 feet in height measured from floor, and the lading is not loaded in pyramidal form, the stakes must be as high as the lading and must be tied together at the top with not less than eight strands equal to four wrappings of good ⅛-inch diameter wire and must be tight. Stakes must be sound hardwood, free from knots and of the dimensions specified in general rule No. 12."

"Rule No. 57.—If the material is loaded on flat cars or gondola cars with sides less than 30 inches high, to a height more than 4 feet measured from floor, opposite stakes must be bound together with wire at about one-third of the height above car floor after one-third of the load has been placed on the car, and in such a manner that when the remaining load is placed on the car the wire will have a tendency to draw the tops of the stakes toward each other. The middle as well as the top wrapping of wire must consist of not less than ten strands equal to five wrappings of good ⅛-inch diameter wire and must be tight. Bearing-pieces may be placed between the lower and upper sections of load to facilitate application of wire after all the lading has been placed on the car. Stakes must be sound hardwood free from knots and of the dimensions specified in general rule No. 12. Stakes must incline toward center of car a total of about 12 inches before load is placed on car, and in no case will they be allowed to incline away from center of car after the car is loaded. The inspector must assure himself that all wiring is tight before load is moved."

Rule No. 58.—Insert the figures "4½" just preceding the word "live" toward end of fourth line, which will then show size of saplings, making the first sentence read as follows:

"When lading is placed inside of a single gondola car with sides 30 inches high or over and load projects above car sides, not less than three pair 4 by 4 hardwood stakes or three pair of 4½-inch live saplings should be well secured to either side of lading on inside of car for piling or props 20 feet or less in length."

Also add the following paragraph to this rule:

"When lading is in two piles not over 20 feet in length and ends of piles are interlaced at center of car there must be not less than five pairs of stakes for total length of load. If the length exceeds 20 feet there must be not less than six pairs of stakes for total length of load. The ends of poles must extend not less than 18 inches beyond the center stake."

Rule No. 81.—Some suggestions have been made with reference to handling twin loads of flexible material where the shipment is light and can be handled safely without the use of blocking prescribed for full loads, and in order to make this entirely clear, the following paragraphs should be added to this rule:

"81-A. If the total weight per bolster does not exceed 10,000 pounds, the center post and bolster cross braces may be omitted, provided the bearing-piece is not less than eight by ten inches (8x10 inches).

"81-B. For twin loads of plates with two bearing-pieces and two or four sliding pieces, if the total weight does not exceed 20,000 pounds, or 10,000 pounds per bearing-piece, the center post and bolster cross braces may be omitted, provided the bearing pieces are not less than eight by ten inches (8x10 inches).

"81-C. For loads less in weight than those specified in paragraphs A and B, the dimensions of bearing-pieces may be proportionately reduced as per rule No. 29."

Rule No. 98-A.—Add the word "cars" after the word "hoppers" in the first line last paragraph, which would make this paragraph read as follows:

"When hopper cars or self-cleaning hopper cars are selected the doors must be securely boarded over."

Rule No. 103.—In order to bring the weight of the lading nearer to the allowable limit for double and triple loads, the following paragraph should be added to provide that girders, either of the solid or latticed type ranging from 10,000 to 30,000 pounds each in weight, shall be so arranged that two or more can be loaded side by side on pivoted bolsters:

"Two or more girders may be loaded vertically, side by side, provided they are bolted together near pivoted bolsters, with proper spacing-pieces between them, in such a manner that they act as one girder."

Fig. 56.—It is claimed that the method of loading pipe 24 inches or more in diameter on a flat car in accordance with the present figure is wrong on account of there being no provision for holding the second and top tiers of pipe from sliding off endwise. Pipe of this description should be loaded with the bell ends toward the center of car, the bell ends of the second tier overlapping the first toward center of car. There should be at least 18 inches clearance

between the bell ends of the top tier and when loaded in this manner the end blocking is not required, therefore Fig. 56 should be changed accordingly.

Rule No. 121.—Due to objection on the part of the shippers to the size of blocking now specified, and due also to the fact that blocking of smaller dimensions can be used without interfering with the safe movement of boiler shells and tanks, this rule should be changed to read as follows:

"Lading of this description eight feet or less in diameter, when loaded on single flat or gondola cars, should be substantially chocked with side blocking in height equal to one-seventh the diameter of the shell, providing that blocking of more than ten inches in height will not be required. End blocking to be not less than four inches in height.

"Lading over eight (8) feet in diameter, when loaded on single flat or gondola cars with sides less than 30 inches in height, must be substantially chocked with side blocking not less than ten (10) inches in height and backed up by the use of stakes in the stake pockets, and in addition to this must be secured with two bands of not less than three-quarter inch round iron or flat bands of equal section. End blocking to be not less than four inches in height.

"When loaded in gondola cars with sides thirty (30) inches or over in height the bands will be unnecessary, but precaution with reference to blocking must be taken as specified for lading eight (8) feet in diameter."

"When such lading is placed upon two or more cars as a tandem shipment it should be secured with two bands of not less than seven-eighths inch round iron or flat bands of equal section, in addition to the prescribed blocking."

"Steel tanks, lined or unlined, in sections weighing not over 2,500 pounds per section, eight feet or less in diameter, when loaded on single flat or gondola cars must be substantially chocked on each side with blocks not less than six inches in height and of sufficient length and width so that they may be securely spiked to the floor of the car. End blocking to be not less than four inches in height and of sufficient length to provide for proper bearing area against head of tank or shell and to be securely spiked to the floor of the car. If more than eight feet in diameter the same side and end chocking is to be used and in addition each tank or part of tank must be secured with two bands not less than ⅛x2 inches in section passing over the top and properly secured to the floor or stake pockets of the car. In lieu of the bands over the top of the shell the same may be secured to the floor of the car or stake pockets by straps of ¾-inch round iron or equal section bolted to the flange of the tank or shell with not less than two bolts, the lower end of the strap passing through the floor or stake pocket.

Rule No. 124.—The committee has had some correspondence in reference to some modification in the latter part of rule No. 124 referring to the necessity for protection strips being placed in the door openings on cars not equipped with doors where such cars are loaded with a commodity requiring that the door openings be protected. As the rule now reads, the lading must be protected by placing strips or slab wood, whether the lading does or does not require it; hence, we felt that some latitude might be given the shipper and therefore wish to add after the words in the second sentence, "cars without doors" the words "and containing freight of a character requiring it." This would make the second sentence of rule No. 124 read as follows:

"Cars without doors, and containing freight of a character requiring it, must have the lading protected from falling or rolling out of car by strips or slab wood, not less than 1½ inches thick at center, nailed to inside of door posts, and sufficiently close to floor of car and to each other to prevent lading from passing between them."

We have also had a great deal of correspondence recently in reference to the subject of proper method of loading triple loads of long flexible material (angle irons and plates) as specifically referred to in paragraph 15-E on page 10. It is a fact, if such lading is built up in accordance with the present prescribed practice, and the load bears on the sliding pieces on the center car, there is some danger of upsetting the car on account of the lading shifting or sliding toward the outer edge in going around a curve, and by its bearing rather heavily at this particular point would contribute to the greatest liability of derailment. Still, we do not feel that we have as yet obtained sufficient data or information along this line to warrant changing the present practice or adding any additional rules to the code; it being our idea that such shipments for the present should be handled under special instructions until we have an opportunity to further study the subject with a view of ascertaining the best and safest practice for shipment of such material.

In conclusion, we wish to again point to the disadvantage under which your committee is oftentimes laboring in its endeavor to put the rules for loading material in the best and most desirable shape for all concerned as referred to in the latter part of our report in 1910. It is reasonable to suppose that new problems in connection with loading material are presenting themselves throughout the year which are very often met at the time and satisfactorily adjusted, but we feel that few, if any, of these difficulties as worked out are presented to us for consideration, whereas they would perhaps be very valuable information and materially assist your committee in its work. During the current year, however, the committee has received a great deal more assistance than heretofore.

(Signed) A. Kearney.
R. E. Smith.
C. H. Osborne.
W. F. Kiesel, Jr.
L. H. Turner.

Discussion.

A. W. Gibbs: Is the requirement included, that the car shall comply with the clearances for the electric third rail as adopted by the American Railway Association last month?

A. Kearney: I do not think there would be any conflict with rule No. 6, as this places the burden on the railway having the disability. Since this report was written we have had correspondence with the Ohio Quarries Co. and the Cleveland Stone Co. with regard to loading stone. Also with the National Tube Co. and the Carnegie Steel Co. Would like to know if it would be satisfactory to have the committee go over the questions submitted and submit conclusions. The subjects brought up by the Carnegie Steel people are with respect to plates which are too wide and have to be placed crosswise in the car and held in place by clamps.

C. A. Schroyer: I move the report be accepted and be submitted to letter ballot.

C. E. Chambers: I am not quite clear whether the recommendation of the committee is that whether our rule 6 and rule 15 of the American Railway Association will put the expense on the loading road if the loading road does not load according to the proper clearances.

A. Kearney: A few years ago we were asked to change rule 6 to make it harmonize with rule 15, which placed the responsibility upon the road having the disability. The General Managers' Association thought this unfair and decided to accept the loads on open cars.

Mr. Schroyer's motion was put and carried.

DAMAGE TO FREIGHT CAR EQUIPMENT BY UNLOADING MACHINES.

The committee, instructed to investigate the damage to freight-car equipment handled through dumping or unloading machines, wishes to report that it finds very valuable work has already been done in the same direction by several railroads whose equipment, in rather larger proportions, has been handled through such machines, and as a result has sustained considerable damage.

The Pennsylvania and the Lake Shore & Michigan Southern took hold of the question some time ago and were very successful in locating several fouling points and parts throughout a number of unloading machines responsible for damage to cars. These two latter roads also sought to secure interest on the part of other railroads, and possibly joint action between railroads toward obtaining uniformity with reference to the relative location of bearing-blocks, plates, etc., in the machine, as well as uniformity as far as practicable in the car equipment itself.

Some time ago a committee was appointed on the Pennsylvania to investigate the subject and to make observations where some of the larger unloading machines were in use; they found that more than 95 per cent of the cars were damaged in one way or other as they were handled through the machines, and further that the safety appliances were damaged on something like 32 per cent of the cars.

It seems this situation arose principally through lack of uniformity in unloading machines as well as in cars, and that the greatest percentage of damage is occasioned by the condition and relative position of the clamps, also the breast plates, blocks, etc., against which the cars rest while being rotated in the machines.

The railways have not been working without co-operation on the part of the manufacturers of unloading machinery, as the latter have been able to show, by modification and improvement in the designs of their machines, that an earnest study has and is being given the subject with the view of reducing the defects in the machines.

It has been the thought of your committee that if they were successful in securing plans from the manufacturers showing the relative position of bearing points assumed by the cars as they are handled in the machines and then develop a composite diagram showing the relative position and limitations of such areas, they should be able, after possibly some further analysis of the various classes of equipment, to point out the safer and more desirable areas to rely upon, and those that should be diminished or possibly totally avoided.

It has also been the idea that if it will be possible to gradually reduce the increasing variety in car designs in such parts, at least as foul the lines and areas as might be determined upon, a great deal will have been accomplished toward reducing the expense now incurred on account of damage to cars, and at the same time minimizing delays to equipment.

Recent legislation with reference to ladders, handholds, steps, etc., will, to a degree assist in controlling some of the projecting parts, but even the relative position of these vary to some extent on account of difference in length of cars; therefore, we still have before us the main question of reducing or definitely specifying areas for projecting parts, such as location of the stakes, rope staples, handholds, door openings, shafts, etc.

It was hoped by this time more information would be secured with relation to dumping machines, also composite diagrams from all roads showing the various classes of freight equipment likely to be used in such machines, believing that with complete information along this line some headway might be made by putting the respective composite plans together into one large sheet so as to show to the builders of machines, as well as to railroads and car builders, the bearing areas they have each independently appropriated. Such information should enable us to definitely see the bearings and areas that should be respected in future designs for machines and car equipment, assuming it is of sufficient interest to some roads to reduce the fouling points in some of their equipment, thereby working further toward gradually approaching lines that might be profitably pursued for existing equipment.

The work of your committee has convinced them that the two

phases of the question, namely, the one relating to the design of the machine, as well as to the car, are so intimately associated that the best results are only to be accomplished by endeavoring to solve the two problems together; but to what extent it is going to be possible to do this remains to be seen. Your committee has been working earnestly since it has had the subject in hand, and regrets to report its inability to accomplish more than has been done up to the present time; they feel it would be unwise to attempt to draw definite conclusions with the limited information it has so far been able to gather. It is fair, however, to mention that while they have had enthusiastic assistance from certain quarters, both on the part of railroads as well as the manufacturers of unloading machinery, they feel confident that the field has not been covered, and, therefore, the work is still incomplete.

It may be of interest to mention that the work of the committee seems to show that so far as the types of unloading machines are concerned, we have practically three schools of design to meet. While the various types differ somewhat in detail, the general arrangement or systems are represented by the three following descriptions:

First—One in which the car is run onto a supporting track, which slides transversely on a cradle, being held in place by clamps from underneath when the machine is in its normal position. Four chains are passed through hollow hook clamps to counterweights on the opposite side of the machine and are attached to the supporting track. The hook clamps move vertically in guides on the cradle sides, and are held at a height sufficient to clear any car by means of vertical rods which extend to seat blocks underneath the cradle. When the cradle is raised the cams disengage and the supporting track is pulled over by the counterweights until the weight of the car braces itself against the cradle side. The hook clamps fall by gravity until they have assumed a bearing on the top flange of the car.

Second—One in which the car is run onto a supporting track which tilts on a horizontal shaft until the car has a bearing on the cradle. This arrangement has chains and hook clamps as above described, but the latter are anchored in the cradle side instead of to the supporting track.

Third—One in which the supporting track is stationary, and the cradle side is moved inwardly and up against the car by pistons.

In all three types of machines the clamping arrangements are quite similar, consisting of hooks and clamps. In the general construction of car-dumping machinery it is necessary to provide for handling not only the largest cars offered, but it must also be capable of turning cars much smaller in size and capacity without damage. For this reason, therefore, it becomes necessary to so arrange the track-dumping arrangement, clamps, bearing-areas, etc., in such a way that they will be adaptable to all cars.

A great deal of damage now sustained by the equipment is due to the manner in which the car is seized by the clamps and other apparatus belonging to the dumper, and the bearing the car assumes up against the side of the cradle, also in some instances on account of clamps being missing and chains alone being used to hold and steady the car. In some machines the cradle sides are constructed with insufficient bearing surface for the car to rest against, or they have bearing surfaces fouling the ladders, grabirons and other parts of the car as it is being rotated in the unloader.

In the revolving type first described the lifting as well as the rotating motion of the machine carries the car sidewise until the car sides rest up against the cradle, regardless of the width of the car. This is for the purpose of supporting the car on its wheels and on one side in the rotating movement.

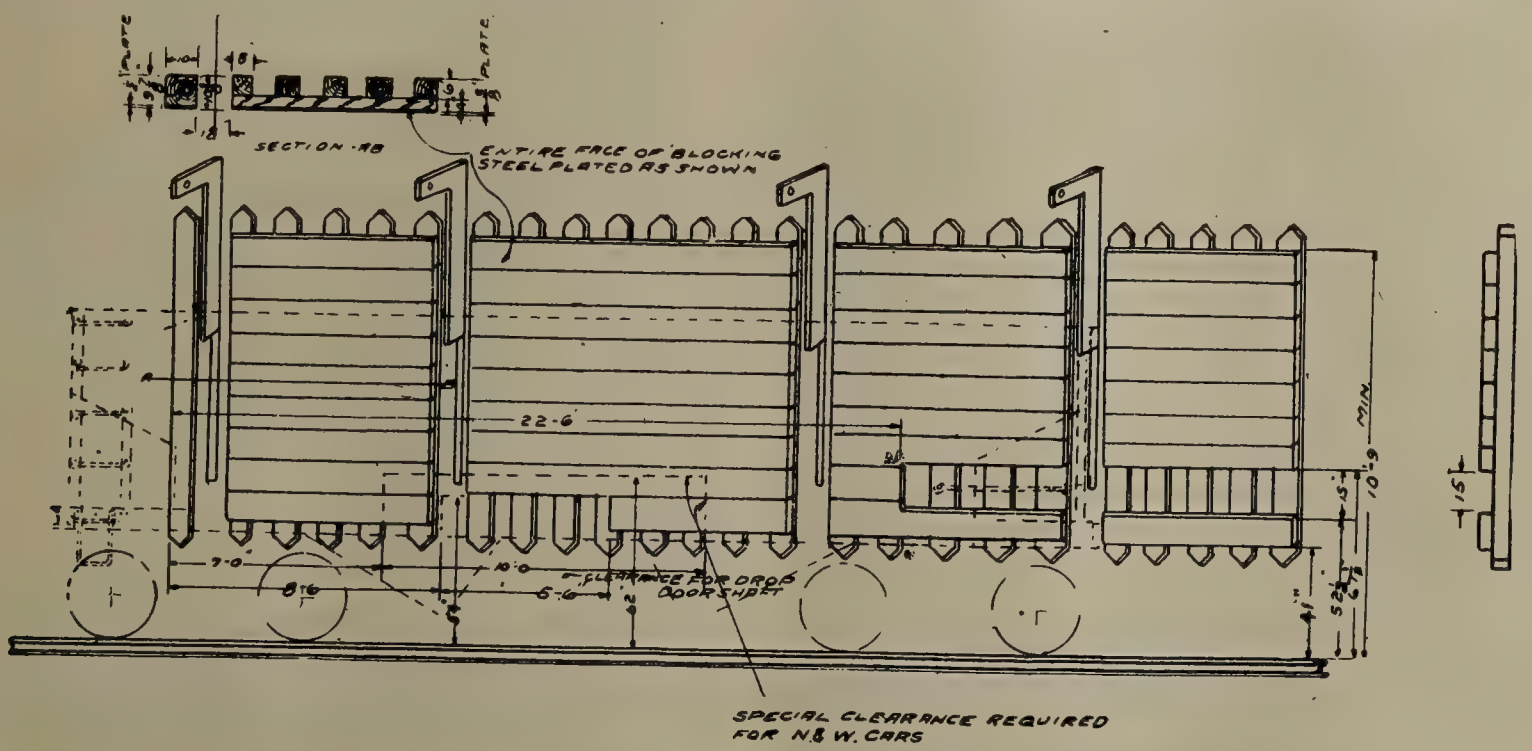
There was a joint committee representing several roads sent out not long ago to examine a number of dumping machines, and their report was to the effect that they considered it possible to readily modify the cradle and blocking of the first two types of machines so that the safety appliances and other parts would be subjected to little chance of being damaged. A modification in the third type, however, would seem to be more extensive.

We are submitting herewith a diagram showing recommended dimensions for cradle sides, which it is believed will diminish, to a very large extent, the damage to cars, provided each car is properly spotted. The support of the sides of the car consists of four sections, each composed of 6 by 8 inch vertical pieces, upon which are carried horizontal boards 4 inches thick fastened thereto, and plated with ⅜-inch steel. The proposed design of extension clamps is shown in detail on the print.

The cars are intended to be spotted so that the ladder end is clear of the end section. The two sections at the opposite end are cut out to provide clearance for the side handholds for cars of various lengths. The dotted lines covering part of Sections 1 and 2 show the amount that must be cut out for Norfolk & Western cars where the drop door rigging is located rather high and spaced farther apart than on many other classes of cars. This recess need not be provided except on machines in territories where such cars are handled.

Your committee, in submitting this report of progress, wishes to state that while their investigations are unfinished, the subject is of such wide importance that we would ask for further time; it being their idea, provided it meets with the approval of the association, that they immediately ask all railroads whose cars are handled through dumping machines to make a composite diagram of the various classes of their freight cars likely to be handled through such machines, sending same to us on a prescribed blank filled out as will be illustrated. From this information the committee will be able to make a large composite plan, and be able to determine whether ample provision for clearances has been provided so as to avoid some of the damage now being occasioned. Such a diagram will also readily show how cars compare with each other in this respect.

Such data when compiled should suggest conclusions as to what might be done, at the least cost, toward securing uniformity in existing cars, and what might seem profitable lines to be observed in the construction of new car equipment and unloading machines.



Dimensions for Cradle Sides.

(Signed) A. Kearney.
W. F. Kiesel, Jr.
R. E. Smith.
C. H. Osborne.
L. T. Turner.

Mr. Kearney stated that since preparing the report the subject had been talked over with some of the manufacturers of unloading machines and that they are all willing to help.

Discussion.

Henry La Rue: We are not in the Lake district, but are concerned with the use of unloading machines. We are using dumping machines in connection with mineral products and cements and find that serious damage is being done to cars. I would like to hear from someone as to who is responsible for damage done to cars by unloading machines.

I. S. Downing: I am on a committee which is investigating this matter in the Lake district. At Sandusky we handle a great many Norfolk & Western cars. Sometimes when the car is turned on its side the shaft will project beyond and shove the side of the car in. This has happened with Pennsylvania cars and they have been held responsible. The old style machine with air plunger does the damage, and it is important that some general practice be adopted. The steel and coal people do not want to have to change the blocking every few months, and the blocking shown here will take care of the safety appliances. In building cars the builder should consider the cradles of these large machines.

R. L. Kleine: I agree with Mr. Downing that the committee's design is a good one. I wish to raise a question with respect to the reinforcing plate which they apply on the face of the planking. In winter the cars would be liable to slip along these plates, which

would not be the case if they had wooden blocking. I think the committee should be continued so that they can go further into the subject.

J. J. Tatum: About two years ago we found that dumping machines were doing damage on account of the method of blocking. Since then we have located the blocking so that much of the damage has been done away with. The fellow who comes along with a clam-shell bucket to take out a portion of an excess load and takes out the cross bracing is causing trouble. New rule 15 will cause some trouble for us, as it will allow our cars to spread.

A. Kearney: How would the loads be distributed on the sides of the car to which Mr. Tatum refers?

J. J. Tatum: Sometimes the blocking was so placed that it would bear on an area of the sheet that had no support inside the car and it would crush the car on the inside. We prevented this by placing the blocking so as to be back of the inside supports. However, besides crushing in of the sides, we had trouble by the damaging of safety appliances. The blocking was not deep enough and did not have the necessary clearance.

A. Kearney: You mean that because of not having sufficient bearing the cross braces will fail?

J. J. Tatum: Yes.

I. S. Downing: With respect to the plate recommended by the committee to prevent wear, would say that we found that the horizontal and vertical blocking was badly worn and that there would not be an even bearing along on the angle of the stakes.

The report was accepted and the committee continued.

H. L. Trimyer: I would suggest that the committee on prices for labor and material be continued for another year. A great many questions will arise which will be referred to the arbitration committee and this committee should be able to help the arbitration committee. A new price to be considered is the welding of tank cars.

Mr. Trimyer's suggestion was referred to the executive committee.

OVERHEAD INSPECTION OF BOX CARS.

The committee has given the subject a great deal of time and study and feels that certain steps can be very profitably taken working to the standardization of rules, and their suggestion is appended as a part of this report. For the purpose of giving a better idea of the widespread interest the subject has assumed, we think it well to review some of the references already made to the topic and its related phases. Some of the matter may not be germane to the question in the hands of your committee to investigate, except in part; at the same time in an effort to formulate methods and practices for the prevention of losses we are very much of the opinion, and we believe it would be the judgment of many, that it is not always certain as to exactly how much of the resulting damage to the shipment belongs to the condition of the car—how much belongs to the manner in which packages are made up for shipment—how much they are damaged as a result of packing and stowing away in cars—how much is the result of rough handling, and how much is due to the shrinkage incident to the method of transportation. A casual thought upon the latter phase of the problem will probably convince any one that all of these conditions, to a more or less extent, carry responsibilities.

In addition to this we have to consider the result of careless repacking and rehandling on local trains when part of a car is unloaded at stations and the remainder of the contents of the car is insecurely packed and braced against normal handling of the train, to say nothing of what might be the result of damage on account of rough handling.

Another very important condition confronting us is the ability to readily secure the necessary supply of equipment in the event of specific and more stringent rules being established for the selection of cars, separating them for certain commodities. To any one who has had an opportunity to see what often develops in yards and how difficult it is to get sufficient equipment under the present practice, it would seem certain that any further restrictions, or any new conditions instituted, that might in any way result in still further diminishing opportunity to readily get sufficient equipment, might prove disastrous to the degree of almost causing a cessation of traffic locally.

From 1900 to 1910 the payments by the railroads for freight loss and damage per annum have increased in the United States from $7,055,622 to $21,756,671. These figures do not include the enormous clerical expense involved in the investigation and handling of claims. Furthermore, it is estimated that the unreckoned inconvenience and loss of time, by the public, incident to these failures of transportation, represent another loss about as great.

The extent of this apparent loss has become a matter of so much concern to the managements that the American Railway Association has taken official cognizance thereof, through its Committee on Relations between Railroads, and a special committee, composed of three representatives from the three General Managers' Associations, has been created, and is known as the Committee on Marking, Packing and Handling of Freight.

This special committee has gathered a great deal of very valuable data, and its statistics relating to losses growing out of or incident to, the condition of car equipment seemed to be of so much interest, that Mr. Hale, chairman both of the special committee and the Committee on Relations between Railroads, raised the question with the Master Car Builders' Association, suggesting a joint meeting between their Executive Committee and the Sub-committee on Marking, Packing and Handling of Freight, which was held in New York in December, 1911. It was at this meeting that Mr. Hale presented statistics covering losses from the various causes mentioned, and announced that since some of them seemed to illustrate phases in which the Master Car Builders might be interested, they were offered for consideration, adding further that if their Committee on Relations could in any way assist towards bringing around further economies, as far as could be prudently pursued (provided it did not mean net loss in other directions), they would be not only willing but anxious to work with the Master Car Builders or any other committee assigned by them to that end.

Inquiries had been sent out by the Committee on Relations to some of the larger systems asking for amount of claims paid on account of defective equipment covering the month of November, 1911, resulting in the following:

Total mileage of roads reporting	82,360
Gross earnings	$111,004,783.00
Claims paid:	
Account of leaky cars	22,228.10
Defective cars leaking contents	19,919.89
Projecting nails, etc	529.08
Dirty cars	1,625.61
Other causes	1,341.37
Total claims paid as above	59,650.15

While the roads reporting showed an aggregate mileage of 82,360, with gross earnings amounting to $111,004,783, and a total amount in claims of $59,650.15, it is possible that some of the claim figures are incomplete; still the details are of interest and should be accepted as showing in the aggregate the extent of such losses. Going a step beyond this the committee has equated the figures, calculating what the loss might be per year for all roads which totaled, as will be seen, $139,194.01. The details are as follows:

Gross earnings for the year	$259,061,997.00
Damage claims per year from—	
Leaky cars	51,919.37
Projecting nails, etc	46,351.61
Dirty cars	3,793.04
Other causes	3,062.27
Unclassified	32,710.59
Total	139,194.01

While the losses directly assignable to defective car bodies are not the largest feature of the total loss, it is probably true that such items as inefficient car doors (facilitating robbery or pilfering), etc., represent another considerable source of loss indirectly chargeable to the cars, which do not appear in the figures.

It seems to be generally conceded that by closer inspection of cars selected for certain shipments attended by more thorough and complete repairs, which is going to mean a larger repair cost, a higher standard will be maintained, but it is an open question as to how much extra expense would be justified in order to overcome the claim losses due to defective equipment. However, it seems to your committee that without directly undertaking an answer to that question, there are two distinct avenues through which an improvement can be directly approached, namely:

First—Concentrate the responsibility for losses due to defective car bodies in such a manner as to provide an automatic incentive for the use of better cars.

Second—Establish standard requirements for the inspection of car bodies.

We find that the General Managers' Association of the Southeast has been giving a great deal of attention to the general question of freight loss and damage, and the feature of defective car bodies has been under consideration. On April 9, 1908, they called a general meeting of officers of several departments of lines in their territory to which representatives of roads in other sections were also invited, and we find in their minutes the following:

Defective Cars.—A Committee on Loss and Damage made a report as follows:

"It is unfortunately true that the scarcity of equipment has almost compelled the use of cars which were defective in roofs, doors or end windows, but which were kept in service as long as the running gear was entirely safe. We would suggest a closer inspection of the bodies of cars, especially box cars, before loading, projecting nails removed, and if roofs and sides are defective, that they be placarded, 'Not to be loaded with freight that could be damaged by rain,' and be loaded towards home with non-destructive freight, in order that owners make thorough repairs necessary, before cars are again permitted to go in service."

This recommendation was unanimously approved and endorsed. The present car doors and car-door fastenings were also condemned, and it was the sense of the meetings that it was very important that a more satisfactory door and secure fastenings for car doors be devised. It was the unanimous opinion that car doors and fastenings should be more closely inspected and repaired.

They followed this up by correspondence in various directions, a copy of the recommendation being sent to the Master Car Builders' Association, among others. The result of their inquiries was, they reached the conclusion that the rules of the Freight Claim Association so operated as to split up the loss in each case between all the lines participating in the haul, so that the gravity of the deficiency was not brought home to the original loading road. It appears in claims of this character the loading line can thorw the loss on the route as a whole by showing that there had been the "usual and customary" inspection at point of origin. This is so vague as to really mean little or nothing, according to the laxness of the custom of inspection of car bodies at loading point.

Therefore, on December 10, 1908, a resolution was adopted by the General Managers' Association of the Southeast, as follows:

"Whereas, Recognizing that important factor in causing loss and damage to freight, defective car bodies, leaky roofs, doors, end windows and sides, it has heretofore been recommended that such cars be placarded, 'Not to be loaded with freight that could be damaged by rain,' and

"Whereas, Ruling L-1 of the Freight Claim Association provides that any member having knowledge of a leaky car shall report same to the officer in charge of operating department of this road, that necessary action may be taken with the proper officer of the line owning the car. But

"Whereas, Ruling I-4 of the Freight Claim Association so modifies Loss and Damage Rule 13 by providing that 'clear evidence of inspection' means 'the usual and customary method of inspection at the point of loading for the commodity with which car is loaded,' so lightens the responsibility of the loading line that Ruling L-1 has been so continually overlooked as to have become practically obsolete, and fails in its purpose; and

"Whereas, In order to reduce to a minimum the loss occasioned by the use of cars with defective bodies, an ounce of prevention is necessary, and our conclusion is that an incentive should be provided to bring about closer and more careful inspection of car bodies, immediate reports of defects, and the placarding heretofore recommended; therefore, be it

"Resolved, That the entire responsibility for all loss and damage arising from defective car roofs and bodies be centered upon the line loading the car, and that it shall be the duty of said loading line, in order to relieve itself, to produce clear and specific proof—not 'usual and customary inspection'—that the defects did not exist at the time the freight was placed in the car.

"And the Chairman is hereby instructed to transmit this resolution to the Freight Claim Association, with request that it be acted upon, and a suitable rule be framed for adoption at their next meeting."

We understand the Freight Claim Association has failed to act on this, even as yet, but at a Joint Convention of Freight Claim Agents representing three Atlantic Seaboard Organizations, i. e., the New York Claim Conference, the Southeastern Claim Conference, and the Virginia Claim Conference, to which your committee was invited, this matter came up, and after full discussion, a resolution was unanimously adopted, as follows:

"Resolved, That it is the sense of these Conferences that, in order to provide an incentive for the more thorough inspection of car bodies, the Rules of the Freight Claim Association should be so amended as to place the burden of responsibility more positively upon the loading line, to show evidence of proper inspection before loading."

End Window.—The Southeastern Claim Conference reported to the General Managers' Association of the Southeast on September 9, 1910, that the lack of proper inspection of end windows and fastenings before loading was the cause of loss by robbery, and damage from rain, cinders, etc., and there was considerable discussion as to the advisability of abolishing end windows, which resulted in a special inquiry and developed that several lines reported that the end windows had been abolished, and a recommendation was adopted as follows:

"As the end windows afford an easy means of access for thieves, admit rain, cinder and dirt, with consequent damage to certain commodities and to a considerable extent destroys the effectiveness of seal records, it is recommended that the practice of equipping straight box cars with end windows be discontinued, except where the traffic demands otherwise."

Protruding Nails and Bolts.—The committee on maintenance and mechanical matters of the General Managers' Association of the Southeast made a special examination at Atlanta and Chattanooga as to the number of protruding nails, in cars, with the following result:

	Cars Examined.	Nails Projecting.	Bolts Projecting.	Nails Bent Down.
Atlanta	425	15,362	867	11,929
Chattanooga	305	13,243	286	6,312
Total	730	28,605	1,153	16,241
Average	...	40	1 4-7	25

Of the 13,243 projecting nails found in cars at Chattanooga, 3,518 were found above belt rail and 9,725 below the belt rail. Something like twenty cars were inspected at Chattanooga in one day and it was found that not over five, possibly ten per cent, of the protruding nails had worked out of the cars, the vast majority of them having been used in order to hold lading. In the four corner posts of one car were found 102, 100, 94 and 67 bent down nails, respectively.

Leaky Roofs.—In a report on defective car bodies presented at the October meeting of the General Managers' Association of the Southeast, the statement was made that a great deal of trouble was being experienced on account of leaky roofs, causing damage to merchandise, sugar, flour, cement and other freight subject to damage by water, and an earnest request was made that the railroads institute an active campaign to improve condition of roofs, sides and doors of their box car equipment. In this connection the following record was presented by the St. L. & S. F. R. R. purporting to be the result of an investigation showing the condition of car equipment found at their Springfield station platform on a certain day:

Forty-five (45) box cars out of fifty-two were leaking; thirty-eight cars leaking through the roof and seven through sides only; a total of 152 roofs leaking with an average of four leaks to each car.

Inspection Card.—Another committee recommended the use of a card certifying as to the proper condition of car when furnished for any specific load, and suggested that such cards should cover a more thorough inspection as to the suitability of a car for a given commodity. Furthermore, along this line of handling the work attention was invited to the system in vogue on the Frisco, which had been reported as being very successful in materially reducing the number of claims which they felt satisfied would otherwise have been incurred. The card used by this road is one about 8 by 6 inches, printed in red.

This card, while it would seem to cover flour shipments, is used, as we understand it, for other commodities susceptible to damage by water, such as cotton piece goods, grain, plaster, sugar, rice, etc. The use of the card by the Frisco carries with it the understanding between the railroads and the mills and other shippers that they must not load a car with flour or mill products until one of the cards is attached to the car, and when car is loaded the card must be removed from the car and turned into the agent to be attached to the duplicate bill of lading, and the agents are instructed not to sign bill of lading for flour or mill products until such card is signed by the inspector or the agent's representative, if there is no car inspector at the point of lading. This card is then filed in the station record with the duplicate bill of lading, and in event of a damage claim being presented, the loading station is asked to produce a copy of the flour inspection card. As pertinent to this, in the year 1911 the Frisco system reports having paid $43,150 for claims directly traceable to defective equipment, which amount was 8½ per cent of the total loss and damage to freight handled.

The same General Managers' Association suggests the general adoption of a card, somewhat revised, showing that the car has been examined as to its condition before loading, as per sample, which, as will be seen, is quite similar to the one used on the Frisco.

The Chicago, Milwaukee & St. Paul R. R. reported that it has found it profitable to adopt an inspection card, certifying to the condition of the car before loading flour, on account of the number of cars that have apparently been loaded at stations before they were put in proper condition for such shipments.

The St. Paul further informs us that it was somewhat surprised at the number of cars reported in unsuitable condition for the loading of such commodities, thinking that its own cars in this traffic were in very fair state of preservation, as many of them were taken directly from the repair tracks for loading; therefore, in order to know how foreign cars were running in this respect a close inspection was instituted which showed that out of 100 cars, 65 were unfit for this class of traffic. The report further states that it was also found necessary to make an inspection just prior to the car being delivered to the mills. Cars going off the heavy repair tracks are marked as good for flour loading, and it is their practice to then attach a card to the car to this effect. Any other cars delivered for such loading, including the cars marked O. K. as shown by the card certificate, are reinspected immediately prior to being sent to the flour loading tracks, and it is from this inspection suitable cars are selected. The inspection is reported as resulting in rejecting a large number of cars for this particular service, the percentage of foreign cars rejected running as high as 65, but this extraordinary inspection seems to be essential for the class of shipments referred to.

The Chicago Great Western R. R. reports that at Minneapolis, where it handles heavy flour and grain shipments, it has introduced, with very good results, a special overhead, as well as interior, inspection of box cars to insure their being in good condition and clean, thus making them suitable for such shipments. Furthermore, it is stated that in its inspection they often find floors in bad condition with oil-soaked boards and being otherwise fouled by previous shipments, thus preventing their safe use for the transportation of flour. Where the floors are somewhat foul and the car otherwise in good condition, the floors are painted over with a quick-drying paint to prevent damage to loading. In the selection of cars for this service extraordinary inspection is made of the superstructure floor, sides, roof, etc., after which a card is made out by the party making such inspection which is signed by him and turned in as a record of the car being suitable before loading.

Grain Leakage.—In a report on freight loss and damage to the General Managers' Association of the Southeast, March 10, 1910, Mr. Levy explained the method they follow for preventing the leakage of grain, and as it is so much to the point we quote it herewith:

"Through our traffic department, I received a letter from Mr. Christensen, the freight claim agent of the Texas Lines of the M., K. & T., which gave some interesting figures on grain claims. It stated that the Galveston Wharf Company, at Galveston, a port that exports considerable grain, made a test inspection of 7,429 cars of grain unloaded at their elevator, and found that 4,859, or 67 per cent, were leaking grain, and accepting these figures as being correct it is startling information. Of the 4,859 cars found leaking, 2,381, or 40 per cent, were grain-door leaks; 2,478, or 51 per cent, were due to other defects. In thinking these figures over, we felt that if we could devise some method for doing away with the leaking at the grain doors, we could then, by one operation, reduce by one-half the number of claims for loss of grain in transit. We made some investigation, and found that while our grain doors cost us in the neighborhood of $1.50 to $2 per car, they do not give us the protection against loss of grain for several reasons: The nails are not always removed from the door post, preventing the grain door from fitting tightly against door post,

permitting leakage of small grain between door posts and grain doors. Furthermore, the grain doors, which are made in 20-inch sections, 7 feet long, are of unequal strength. The tendency of the weight is to go downward, and to press out at the weakest point, which is the grain door. Sometimes you will find a car where one of the 20-inch sections is bowed out, allowing grain to run through the opening, and when the car is unloaded, the board goes back to its original position, and you have a perfect car, still you are short a number of bushels of grain.

"We made some experiments, and they are satisfactory and we are carrying them further. We purchased eight-ounce burlap in bales of 2,000 yards, which cost us about a fraction over 4 cents a yard. It requires in the neighborhood of fifteen yards to fix up a car in the manner that I will describe, or 60 cents per car. If we had a claim on a car of grain, it would cost us more than 60 cents to investigate it, even though we could escape payment. This burlap is 40 inches wide and we cut it in strips of 8 feet, and after we place the grain doors in the car, we line the grain door on the inside, one section of the burlap extending about 10 or 12 inches to the center of the car floor, the top section lapping over the top of the grain door and over the first section of burlap 18 or 20 inches, so that when the grain bulges the cloth will draw up, but it will not tear.

"Then all the burlap is held in place by small wooden strips, made out of scrap lumber, which are nailed to the car at the angle of the end of the grain doors and the side of the car, making a tight joint between grain door and side of car, and absolutely preventing loss at grain door. In addition to lining the grain doors with burlap, we put a strip of burlap about 3 feet long over the draft and king bolts, placing a tack in each corner. We require our car inspector to grain door and burlap cars for grain loading, and to show on his grain inspection card, Form 405, that it was grain-doored and burlapped by him. If loaded at a point where there is no car inspector, we furnish the material to the elevator men and they apply it. When loaded to a point on this line, we instruct agents at destination to return burlap to point of loading. At some elevators they tear out the bottom section of the door, and in so doing mutilate one section of the burlap. We write the agents at destination of the grain loaded in burlapped cars and ask if there is any leakage, and opinion of consignee using burlap, and they all report no leakage at grain door, draft or king bolts.

"We feel that 60 cents a car expense is cheap insurance, and we are going to continue that use of the burlap and at the expiration of six months we will be prepared to issue some statistics on both the flour method and the grain method, but we will not get the maximum results unless we can induce other roads to join in something of the same kind."

In connection with the matter of grain loading and defective cars generally, your committee has had its attention called to some rules framed by the Merchants Exchange of St. Louis, as follows:

"Cars to be Loaded.—Carefully inspect both inside and outside all empty cars to be loaded with grain, and if for any reason they are unfit to load notify the elevator foreman that you will not accept them. If they are loaded and let go forward over your protest, note the facts on your report. Go over all cars after they are loaded, tapping the sides and ends; if leakage is observed, insist upon the car being set back unless it is possible to cooper it up so that it will, in your judgment, be safe to go forward.

"Leaky Roof.—If cars have leaky roofs or other defects which is the apparent cause of damage to the contents, a mere statement of leaky roof is not sufficient; call the attention of the agent or yard clerk to the defect as soon as possible. When notice is served a record should be made on reverse side of bad order report showing nature of defect and name of party served, time served and extent of damage if ascertained. Make a joint inspection of the car with railroad representative if possible.

"Grain Loading.—It is important that shippers should carefully examine cars from the inside before loading. Bear in mind that the part of least resistance is first to bulge or burst, therefore double your grain doors; it is better to have them too strong than too weak.

"Never load a car having weak or broken door posts, end posts or side framing, as the lateral pressure in a car of grain is very great and no amount of cheese cloth lining will effectually prevent leakage should the posts or framework burst out.

"The worst leaks and the most difficult to stop are those usually found over the trucks and around the king bolt and draft timbers.

"Make it a rule always to cover draft timbers, especially in old cars where bolt heads are countersunk in the floor.

"Be as careful in your examination before loading of new and newly repaired cars as you are with all others.

"Do not load dilapidated cars nor cars with leaky roofs.

"Spliced doors are always dangerous and should be spiked securely from both sides, making the laps as near to door posts as possible."

The loss and damage exhibits would, at first blush, seem to be appalling, but those who have had opportunity to see what actually takes place, that is, to observe conditions surrounding the opportunity to inspect and prepare equipment offered for loading, and the manner in which some of the more perishable or fragile products are stowed away (especially in mixed loads), to say nothing of the insecurity of packages, are less astonished at the figures; indeed they are sometimes surprised that they are not greater.

The question of formulating any hard and fast rule or inflexible rules for inspection involves a task of such magnitude that even a beginning appears not only difficult but somewhat discouraging. It would seem wise to proceed most carefully and cautiously, otherwise our work may result in going beyond the point of economy.

It is no argument to state that in some instances, and probably in very large proportions, cars are offered in condition unfit for certain classes of commodities; nevertheless, it appears quite true that there are many shipments made in cars in a very much higher degree of repair than warranted by the freight carried therein. Therefore, while there seems to be a necessity for improvement for some classes of freight, it is possible that to attempt to raise all cars to the proper state of excellency for all commodities would result in unnecessary expenditures.

With reference to the overhead inspection where the water test has been employed, it might be of interest to mention that a series of investigations have been made at Vandergrift, Pa., particularly with reference to selecting cars for shipment of certain grades of galvanized iron, which seems to be very susceptible to damage on account of moisture. This may be surprising to those less familiar with the care with which such shipments must be handled, protecting them against the presence of any water; it has been reported, however, that two or three glasses of water poured on a pile of galvanized iron of this particular grade will penetrate the entire lot and discolor the finish of the iron to such an extent that it is no longer marketable except at very reduced rates, hence only that class of cars with roofs proof against leakage can be safely used for such shipments. The conclusion seems to have been reached that the average box car equipment requires some repairs to insure safe shipment of goods of this particular character; also that the water test, while quite effective, nevertheless is quite impracticable in general service on account of the difficulty entailed in making such tests.

Guided by the apparent trend, necessities and many conditions surrounding the question of inspection, your committee wishes to suggest a division of box car equipment into three primary grades, having in mind designating them as being suitable for certain classes of commodities. The wisdom of selecting cars for certain shipments readily damaged by moisture is a necessity as has been shown, and is well recognized by several roads that have already found it desirable to institute a certificate of inspection before loading. Your committee has in mind the apparent wisdom of going somewhat cautiously and shows here appended in detail its idea as to how it thinks the division might be made; at the same time it does not believe it would be well to attempt for the present to go beyond defining the inspection for the commodities readily damaged by moisture, and for the reason that the rough shipments offered and other shipments carried in box cars might take care of themselves a while longer.

There will undoubtedly be a great deal of work to be done in the perfection of the classification of the commodities readily damaged by moisture, as well as the possible improvement in the instructions and definition with respect to the prescribed inspection that should be made of cars offered for such shipments. The fact is obvious that closer inspection is necessary as to the physical condition of the superstructure of the cars for the loading of certain commodities, such inspection to be made in the best possible way to meet local conditions. It is also certain that our minds are made up to the effect that the most earnest and sincere co-operation on the part of all railroads is absolutely necessary, otherwise little can be gained though much money might be expended.

Keeping in mind that we should not attempt for the present to go beyond the first group of commodities, embracing those readily damaged by moisture, it will be observed your committee has not gone further. They are convinced, however, there is an opportunity to effect economy and perhaps definitely and more intelligently control efficiency as far as other factors will permit. Even the subdivisions as covered by arbitrary grouping may need some revision as time goes on, likewise the definition of inspection may be best and most successfully determined by trial and experiment. As soon as the commodities in Classification "A" are finally systematically perfected, the other groups can be given necessary attention.

Your committee believes it is perfectly feasible for all roads interested in this proposition to enter into the work of inspection along the line herein referred to and recommend carrying out, as well, the use of the prescribed inspection card. They again see no reason why the inspection card as well as the method of inspection and classification of cars should not be uniform. Towards the beginning of the committee's work on this subject it was thought that effective results might be quickly secured by the institution of a Bureau of Inspection somewhat similar to the one handling explosives, embracing a certain number of competent railroad inspectors to serve for a year each, or some such arrangement, but their final conclusion is that this should not necessarily be required if all roads will take hold of the work for their own protection. In the twenty-fifth annual report of the Interstate Commerce Commission, issued December 20, 1911, it is reported under the heading of Shippers' Claims, that—

"From their annual reports to the Commission for the fiscal year ending June 30, 1910, it appears that the interstate steam railway lines during that year paid out the sum of $21,941,232 in settlement of claims presented by shippers for the loss of or damage to their freight in transit. For the fiscal year 1909 the amount paid out on this account was $24,916,830 and for the year 1908 such claims aggregated $27,554,526. The payment for the last mentioned year amounted approximately to 1.6 per cent of the total freight revenue of the rail lines so reporting to the Commission. For the year 1909 the amount aggregated approximately 1.5 per cent and for the year 1910, 1.1 per cent of their

total freight revenue. Although it is apparently diminishing in amount, the charge thus made annually against the operating expenses of the rail lines is still substantial enough to be a heavy tax on the transportation of the country."

The method and definition of inspection your committee is suggesting are as follows:

Classification of Equipment for the Following Classes of Freight.

Classification (A)—Freight Readily Damaged by Moisture, such as lime, cement, plaster, flour, sugar, boxed, sack and crated packages of seeds, coffee and merchandise, grain, hay, dry goods and notions, high grades of finished lumber, leaf tobacco, furniture and household goods, and certain grades of tin and galvanized iron.

Classification (B)—Freight Not Readily Damaged by Moisture, such as raw wool, baled cotton, crated china, agricultural implements, barreled liquids, hides, shooks (knocked down boxes), wagons, carriages, tools, stoves and stove castings, certain grades of lumber, etc.

Classification (C)—Rough Freight, such as coal, coke, brick, pig iron, slate, tiling, earthenware, pipe, ties, barrel staves and other rough lumber.

Method of Inspection Before Loading.

(a) Inspection to be made at point of loading whenever practicable, or,

(b) At point of distribution from which car is forwarded to loading station and again by agent.

(c) Cars received and unloaded at stations where no inspectors are located should be inspected by the agent.

Aside from the Master Car Builders' inspection of car, including roof, running boards, air brakes, safety appliances and running gear, as well as the external inspection of sides, ends, doors, ventilators and windows, an internal inspection must be made of the roof and siding, with doors, ventilators and windows in closed position:

1. Search for light indicating openings and cracks which might produce leaks.
2. For loose, damaged and broken boards, loose knots, knot holes, bad joints, etc.
3. For all nails and bolts extending above surface of floor and lining and nails protruding through roofing.
4. Search for water stains indicating cracks and air spaces.
5. Search for cracks sufficient to admit storm water beating through opening, also for openings and bad joints around windows and doors.
6. Examine for metal sheets out of position along edge of subcarlines or down from edge of ridge pole.
7. Search for small holes in metal roofs due to rust or small openings in roof from other causes.
8. Doors must operate and close properly.

The floors should be clean, dry and free from defects sufficient to admit moisture, and any fouling by previous shipments, such as fertilizer, oils, and other freight which would damage more perishable commodities. If the center pin is uncovered it might be necessary to cover it with a piece of board, depending entirely upon the character of freight to be loaded.

Inspect closely for defect in framing which might, by reason of their weakness, allow the sheathing being readily broken or damaged.

Instructions.

After car is thoroughly inspected and known to be in good condition and suitable for the transportation of commodities in Classification (A), the Inspector or Agent, as provided for, making such inspection or able to certify to the condition of the car must make out the prescribed certificate of inspection card, marking same O. K. for (A) classification.

The certificate of inspection card must be delivered to the Agent before Bill of Lading is issued and card must be attached to the Agent's office copy of bill of lading or shipping ticket, for future reference in case of question arising as to the condition of car before loading.

(Signed)
A. Kearney,
R. E. Smith,
L. H. Turner,
W. F. Kiesel, Jr.,
C. H. Osborne.

Discussion.

A. Kearney: This is a progress report. The subject came to us late and we do not feel that we have had sufficient time to cover it. I believe we should change the personnel of the committee and get in members from some Western lines.

F. F. Gaines: The majority of the defects that cause these troubles are minor and the average car inspector is apt not to find them. Who is to make the inspection of the interior of the car? It should not be loaded on our present car inspectors, as they have their duties. I would suggest that a conference be held with the American Railway Association with a view of relieving car inspectors of this work.

F. W. Brazier: I wish the members had been here at the arbitration meeting yesterday to hear the car inspector tell us the amount of money it costs to keep up ordinary repairs under M. C. B. rules. The sooner we get down to spending money on repairs the better. The traffic department is after the business, but they do not give us time to properly inspect and repair old cars. The run, repair and transfer system is wrong; it doesn't give enough time for repairs. In March we had 41 wrecks on our road, caused by broken trucks, because perhaps a nut was missing. We must have some rigid method of inspecting. I want to offer this resolution:

"Whereas, for the safe and expeditious movement of traffic, the freight car equipment of this country should be maintained in the highest state of efficiency;

"Resolved, that the Master Car Builders' Association urge upon the American Railway Association, also on the several general manager' association, the necessity for the authorization on the part of the executive officers of the railways, of sufficient expenditures for the maintenance of freight cars as will attain and maintain this efficiency; and be it further,

"Resolved, that for the purpose of immediate procedure, it is recommended that the members of the Master Car Builders' Association as individuals shall urge upon their several corporations, that, in the case of home equipment when placed empty upon shop tracks or repair branches, it shall be placed in condition for M. C. B. interchange; and in the case of foreign cars, authority shall be granted by the owning road to follow a similar plan, or the car returned to the owner immediately for the accomplishment of this purpose."

On our road we have running repair men and we require all cars to be put into condition, but still we can't keep up with repairs. It is a disgrace to go through the yards and see the condition of the doors and stops. The draft riggings and roofs are also in a terrible condition. We can only remedy this by money and work, and I offer this resolution for adoption.

M. K. Barnum: I wish to second Br. Brazier's resolution. A large number of cars are turned off from the repair tracks before the work is completed. I know of a road that handles a great deal of flour and cement and the superintendent of transportation told me that in order to get 24 cars for this purpose he had to send in 125. I don't think we should be afraid to tell our managers that we need more money for this purpose.

J. J. Tatum: Repair cards will not repair a car. If, after shopping a car, the inspector does not get it to the repair shop, the value of his inspection is lost. It may be best to have some cars for rough freight and others for any other materials which might be loaded into it. If cars are fitted for the best lading and then used for rough lading, they will be unfit for the lading intended, after one trip. In our yards you will find cars with ends broken out and doors in poor condition because they had not been repaired when they needed repair. We should have our cars equipped with good roofs and ends, and the cars should be kept in proper service. We must let the management know the condition of our equipment.

I. S. Downing: We should let the mechanical department know how many cars we want for a certain class of freight. With regard to inspection as brought up by Mr. Gaines, it will have to be done by the inspectors; it is up to them. Besides poor roofs and floors, many cars are equipped with poor draft gears.

C. E. Swanson: I want to speak on the question of insecure side-door fastenings. We have a great many good cars with poor door fastenings. Cars can be entered and pilfered without disturbing the seal and fastening. On our road last year we had 462 concealed losses. A special officer went through our shop with me and sealed and inspected 14 cars from different roads. This officer then entered each of them quickly without breaking the seal and no one could tell he had been in. Then too the back corners of doors are all chewed up and they can easily be pressed outward. On our road we have a loss and damage committee which meets twice a year to talk over these losses, and it is doing much good. The Secret Service Association and the Claim Association are taking up these matters, but it is the mechanical department which gets the blame.

J. J. Hennessey: I move that this discussion be referred to the executive committee and that they refer such of it as they see fit to the American Railway Association.

E. T. Millar: In connection with a number of employees on my road, we tried entering cars without breaking the seal and we found it easy to pilfer cars. We should get a better device for our cars, even if it does cost more.

A. Kearney: We are responsible for the condition of our equipment; we can't blame the management for it. If we do not put the right kind of a hasp on the door we can't blame the manager for it.

F. H. Stark: The matter of handling equipment should be brought to the attention of the general managers. We cannot force railways to keep their cars in better condition by tightening up on inspection. Ten years ago I suggested that if the mechanical department did not take the initiative the transportation department would take over this work. I also suggested that we have a commission to represent all the roads and that we have inspectors to travel over the country. In this way roads could ask a company having foreign cars to make all repairs necessary. The American Railway Association is already looking into this matter and I think the time is coming.

I. S. Downing: If we put cars in perfect condition for M. C. B. interchange, when they come to repair tracks we will have accomplished a great deal in bringing our cars to 100 per cent efficiency.

F. W. Brazier: A few weeks ago we had a foreign car break down and had 41 cars derailed. It may not have been due to poor inspection, but we will always have poor cars. We should get rid of these old cars and get new cars.

F. F. Gaines: We need more money. Shorter hours and cut forces are the cause of much of the trouble.

J. J. Hennessey: If we keep our cars in proper condition we will not need to tighten up on inspection.

D. R. MacBain: I agree with much that has been said, but I think we ought to look back a ways. Before 1907 repairs were slighted to keep cars moving as long as it was safe to run them—we had more business than we could handle. Then the panic came and we have been in bad condition ever since. Roofs and doors

have been neglected and the proper thing to do is to repair them.

M. K. Barnum: If we were to tighten up on inspection we wouldn't have enough cars to handle the business. We have all had the experience, when there was a shortage of cars, of returning to service such bad order cars as were fit to run. During the last ten or twelve years I have figured how to repair cars the cheapest, but have not been asked who was keeping their cars in the best condition. The trouble starts with the buying of new cars. The difference between a first-class door and one that is not, is perhaps a dollar or two, but on a large order it makes quite a difference, so the cheaper door is specified.

Mr. Hennessey's motion was carried.

COUPLER AND DRAFT EQUIPMENT.

This committee, at the 1911 convention, was instructed to report on a standard design for a car coupler.

Standard M. C. B. Coupler.

Each coupler manufacturer has developed, subject to the restrictions of the M. C. B. Association, one or more couplers based upon his own ideas, with particular reference to operation, strength and assembling of parts, evolved from his study of the service requirements and strength desired, but employing certain fundamental principles, consequently the couplers thus produced vary in design and it is neither practical to develop a composite design from the ideas and principles thus employed nor even to standardize any of the individual parts, for example, a uniform knuckle, without employing the principles of one of the designs to the exclusion of all others. As the service conditions increased or the design or strength of the individual type of coupler proved inefficient, the manufacturers developed other couplers in the effort to keep pace with the conditions imposed, which accounts for the number of types of couplers in existence, whereas, practically but six or seven types of couplers are standard at this time among the railroads, although there are in actual use on the equipment from fifteen to twenty types. The increase in the requirements of M. C. B. specifications from time to time is directly responsible for some of these later types having been developed and the elimination of many others, the direct result being the reduction of the total number of types in service.

Much has been said concerning the failure of the couplers and contained parts and the inadequacy of the present coupler to meet the demands of the service in different parts of the country. Your committee in order to investigate these reports and acquaint itself with the different service conditions determined upon a thorough investigation of the performances and failures of the existing couplers so as to determine the limitations of the present M. C. B. coupler and establish a basis upon which to design the standard coupler.

Contour Line Distortions and Coupler Failures.

The chairman was directed to correspond with railroads in various sections of the country to ascertain whether or not it is general that serious trouble is being experienced with coupler contour lines being distorted on certain roads having severe grade and curve conditions, especially where the Mallet type of locomotive is used, and also to learn what difficulties are being experienced in maintaining the present coupler in repairs.

The replies to this circular brought out that there was no more trouble experienced from coupler failures where Mallet type of locomotives was used than with the consolidation or other types of locomotives and that the coupler failures enumerated below were common on most of the roads predominating where heavy service obtains.

Coupler Head.

1. Face of coupler cracking and breaking.
2. Guard arms spreading and breaking.
3. Striking horn crushing in, making lock inoperative.
4. Coupler lugs breaking off, starting from the inside.
5. Knuckle pin holes in coupler elongating.
6. Distorted contour lines.
7. Difficult to couple with slight impact.

Knuckles.

1. Breaking through pivot pin hole.
2. Broken tails.
3. Breaking through shank of knuckle.
4. Worn knuckles at lock-bearing area.
5. Elongation of pivot pin hole.

Knuckle Pivot Pins.

1. Breaking and bending.

Locks.

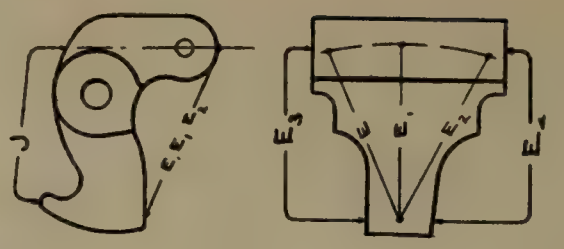
1. Worn and damaged.

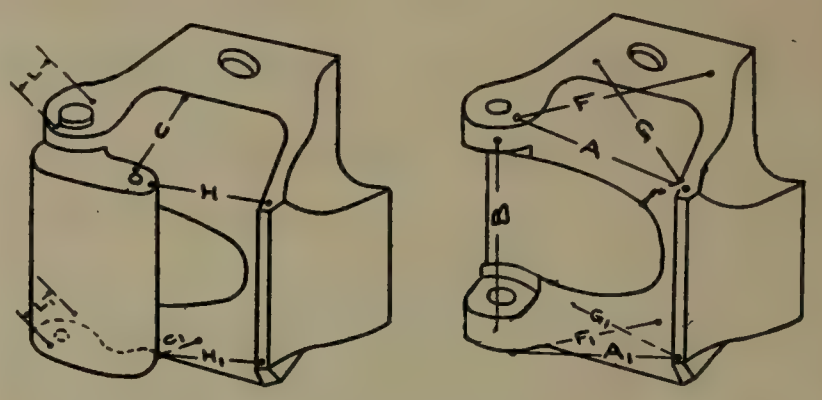
The recommendations contained in the above replies were not very numerous, the most common being as follows:

1. Strengthen guard arms.
2. Increase thickness of front wall.
3. Increase size of coupler lugs.
4. Strengthen side wall back of lug side of coupler.
5. Increase size of knuckle and make pivot pins as large as possible.
6. Modify contour lines to provide for increases suggested in above.
7 Increase lock-bearing area.

The subcommittee investigated coupler conditions during the summer and fall months of 1911 and visited the following railroads, in addition to the roads which they represented:

1. Virginia Railway.
2. Seaboard Air Line Railway.
3. Carolina, Clinchfield & Ohio Railway.
4. Norfolk & Western Railway.
5. Chesapeake & Ohio Railway.
6. Chicago, Milwaukee & St. Paul Railway.





ABOVE DIMENSIONS WERE TRAMMED ON ALL TEST COUPLERS.

REPORT OF
M.C.B. COMMITTEE ON
COUPLER AND DRAFT EQUIPMENT.
1912

EXHIBIT "A"

7. Great Northern Railway.
8. Chicago, Milwaukee & Puget Sound Railway.
9. Northern Pacific Railway.

During the investigation of the subcommittee the common coupler troubles and recommendations heretofore mentioned were kept in mind and thoroughly looked into. Scrap piles were examined, couplers gauged in service and freight trains ridden in order to measure and observe the true actions of couplers in service. Records were taken of the broken couplers, knuckles, etc., and the gauge of couplers in service. The committee has this data at its command to be used in the designing and developing of the standard coupler.

The investigation developed that a large percentage of the coupler contour lines being beyond gauge was due to couplers of old design not being maintained and some of the later types being very poorly fitted up when new; knuckle breakages resulting from air-brake troubles on long trains; and guard arm and face failures, due to rough handling of cars in classification. Knuckle-tail failures were common, attributed in many cases to faulty design. It was quite evident that new couplers did not receive the close inspection necessary to insure proper fitting of the detail parts.

Aside from the above, numerous failures of coupler bodies and contained parts forcibly impressed the committee that the couplers should be materially strengthened, and with a view of determining the increased strength required it was considered absolutely essential that we should establish the strength of the present coupler.

Tests.

At a meeting of the subcommittee in conjunction with Mr. C. D. Young, engineer of tests, Pennsylvania Railroad, on January 16 and 17, 1912, a series of static, drop and road service tests was outlined. This program of tests was ratified at a meeting of the general committee on February 7, 1912, when it was also decided that the time was now propitious for inviting the coupler manufacturers to join your committee in designing and adopting the standard coupler.

Heretofore, all coupler and separate knuckle tests have been made by measuring the ultimate distortion after the final blow as prescribed by the M. C. B. specifications, but in the tests now being conducted the distortions are measured after each drop or pull and tabulated by so much plus or minus from the original dimensions, the idea being to establish the point at which permanent set takes place. Exhibit "A" shows the location of points, etc.

During the last several years the process of heat treatment has been given attention with a view toward increasing tensile strength and elastic limit of cast steel, but couplers have not been, to our knowledge, experimented with, under this process.

Pulling test of the couplers and parts with varying chemistry and treatment are being included in the test program.

The Pennsylvania Railroad has kindly volunteered to conduct all the tests for the committee and they are now under way at Altoona, under the direct supervision of Mr. C. D. Young, engineer of tests. These tests, embodying the features above mentioned, are being carried out on the types and number of couplers shown on Exhibit "B."

The following railroads contributed couplers for these tests: Penna., Southern, B. & O., C. M. & St. P., N. Y. C. & H. R., St. L. & S. F., N. & W., Erie.

Road tests to be conducted are as follows:

By P. R. R.—Twelve couplers; two each of Pitt, Sharon, Gould "Z," Simplex, Major and Latrobe, applied to 100,000 pound capacity

steel hopper cars regularly assigned to the coal trade; three Pitt, three Sharon, twelve Krakau, twelve Simplex Special and six Bazeley couplers applied to steel tenders in freight service. These couplers are to be plate labeled, gauged and trammed before application, and will be followed closely.

By N. Y. C. & H. R. Railroad.—Six Gould "Z" and six Simplex couplers applied to tenders in freight service.

Conferences With Coupler Manufacturers.

As one of the results of the committee meeting of February 7, 1912, the coupler manufacturers were invited to join the committee in designing and adopting one standard coupler, as per resolution adopted at the last convention, and to attend a joint meeting in Altoona on March 4, 1912. The following coupler manufacturers were represented at this meeting:

American Steel Foundries.
Buckeye Steel Castings Company.
Gould Coupler Company.
National Malleable Castings Co.
Monarch Steel Castings Company.
McConway & Torley Company.

The chairman stated the object of the meeting and that it should be distinctly understood that the joining of the manufacturers with the coupler committee in the designing and adopting of a standard freight car coupler is and must be entirely voluntary. Mention was made of the extensive investigation of existing couplers by the committee; that the couplers being manufactured and purchased in accordance with the specifications and test of patents, it is the purpose of this committee to recommend to the Master Car Builders' Association that the owners of any patents involved be given due consideration and settle upon a basis mutually agreed upon between the coupler manufacturers and the M. C. B. coupler committee, so that the standard coupler may be manufactured and purchased in the open market. It is understood that with the design of the standard coupler suitable gauges covering the detail parts will also be included as well as specifications in accordance with which the new coupler must be purchased."

The subject of patents, should they be involved in the standard coupler, was taken up by the manufacturers, and as this is a question of vital importance to the manufacturers and had not been given any thought by them, they were not prepared to discuss it at any length, nor authorized to act upon the same. During the discussion the question arose as to the sale of patents, but the manufacturers would not consider a proposition of this kind; they, however, were of the opinion that a plan equitable to all could be worked out which would enable them to extend manufacturing rights to each other, so that all existing coupler manufacturers could manufacture and sell the standard coupler.

A list of very important and fundamental principles involving the detail parts of a coupler, which your committee had previously decided should be incorporated, as far as possible, in the standard coupler, was discussed pro and con with the manufacturers; a number of these principles were departures from the construction of present couplers.

EXHIBIT "B"

KIND OF COUPLER.	MANUFACTURER.	Couplers of Standard make and Chemistry Donated by Railroads. Kind of Tests. 1 Strike.	2 Guard Arm.	3 Face.	4 Jerk	5 Pulling.	6 Special Face.	7 Special Lug.	8 Special Knuckle.	Couplers of Special Make Bought from Mfrs. and Donated by P. R. R. B (*)	C (†)	D (‡)
Major 5″ × 7″.....	Buckeye S. C. Co.....	1	1	1	1	1	1	1	Use kls. from tests. 2 and 3	7	7	7
Special 5″ × 7″.....	Buckeye S. C. Co.....	1	1	1	1	1	1	1	"	7	7	7
Gould "Z" 5″ × 7″....	Gould Coupler Co....	1	1	1	1	1	1	1	"	7	7	7
Pitt 5″ × 7″.....	McConway & Torley Co.....	1	1	1	1	1	1	1	"	7	7	7
Janney "X" 5″ × 7″...	McConway & Torley Co.....	1	1	1	1	1	1	1	"	7	7	7
Sharon 5″ × 7″.....	National Mall. C. Co.	1	1	1	1	1	1	1	"	7	7	7
Krakau 5″ × 7″.....	National Mall. C. Co.	1	1	1	1	1	1	1	"	7	7	7
Bazeley 5″ × 7″.....	National Mall. C. Co.	1	1	1	1	1	1	1	"	7	7	7
Latrobe 5″ × 7″.....	National Mall. C. Co.	1	1	1	1	1	1	1	"	7	7	7
Simplex 5″ × 7″.....	American Steel Fds....	1	1	1	1	1	1	1	"	7	7	7
Special 5″ × 7″.....	American Steel Fds...	1	1	1	1	1	1	1	"	7	7	7

*Couplers to be made in accordance with the best heat treatment and chemistry which coupler manufacturers can recommend in light of their present experience.
†Couplers to be unannealed and to be 0.35 per cent. carbon, low phosphorus steel for heat treatment by P. R. R. Test Department.
‡Couplers to be furnished in accordance with steel from coupler manufacturers' present foundry practice and chemistry, unannealed, to be heat treated by P. R. R. Test Department. Manufacturers to furnish the per cent. of carbon in the steel.

the Master Car Builders' Association are giving fairly satisfactory service on most roads, but that they all have their detail failures and defects.

It was brought out that an undesirable situation exists, in that practically each coupler manufacturer is bringing out or placing upon the market a new design of coupler every third or fourth year, thereby necessitating the carrying of enormous stock by railroads for repairs. The manufacturers replied that this was necessary by the constantly increasing requirements of the service. The general impression among the manufacturers was that it appears that the present agitation in favor of a standard coupler emanates from an actual requirement of service, and that there is a real reason for it from the standpoint of service and economy to the railroads. The chairman outlined the position of your committee in regard to the probable procedure, substantially as follows:

"The idea is to design the one standard coupler on the best principle or principles known to the art, to be determined from the fundamentals used in the design of present or past couplers and from our knowledge of their behavior in service, eliminating in the new design the failures and proven mistakes in the old. If this can be done without infringing any existing valid patents it would be an ideal solution, in any event it is the purpose to design the best coupler within our power, then submit same to ascertain whether it contains infringements of any existing valid patents. Should it be found that the coupler thus designed infringes any

The coupler manufacturers asked, if they should submit a proposition for a standard coupler that obviated the necessity of turning their patents over to the railroads, and the proposition seemed feasible to the committee, would it be possible for the committee to present it as their recommendation to the M. C. B. Association?

It was decided to give the coupler manufacturers an opportunity to submit such a proposition and the meeting adjourned to meet on April 2, 1912, to further consider the question of one standard coupler and to receive a report from the manufacturers indicating under what conditions they will join with your committee in designing and adopting a standard coupler.

The next joint meeting of your committee and the coupler manufacturers was held at Altoona on April 26, 1912, postponed from April 2, at the request of the manufacturers. This meeting was for the purpose of further considering the question of one standard coupler and to receive a report from the manufacturers.

The proposition submitted by the manufacturers was only tentative, the substance of which was as follows: That all the coupler manufacturers are willing and glad to cooperate with your committee in reference to designing and adopting a standard coupler, and, in order that the work of the committee may be entirely unhampered by any patents of the present coupler manufacturers, the manufacturers have been considering what arrangements could be made between them to this end, which would afford to any company owning patents, which might be embodied in the coupler

selected, proper compensation for the use of these patents as suggested by your committee. The manufacturers had not succeeded in working out the details of such a plan, but they believed it could be arranged.

It being definitely decided that the coupler manufacturers would most readily join your committee in this work, the chief topic of discussion was the question concerning patents, and it was agreed to adjourn and meet on May 15, 1912, at which time the coupler manufacturers would submit a definite proposition.

Accordingly, another joint meeting was held with the coupler manufacturers at Altoona, May 15, 1912, at which propositions were submitted to your committee, which have been referred to the Executive Committee of the Association.

The coupler manufacturers named the following representatives to act with your committee in designing and adopting a standard coupler:

American Steel Foundries, represented by Mr. R. E. Janney.

Buckeye Steel Castings Company, represented by Mr. S. P. Bush or Mr. George Johnson.

Gould Coupler Company, represented by Mr. W. F. Richards.

McConway & Torley Company, represented by Mr. William McConway, Jr.

Monarch Steel Castings Company, Mr. Charles Brush.

National Malleable Castings Company, Mr. H. T. Krakau.

M. C. B. Standards.

1. Location of Lock Lift.—The committee on Standards and Recommended Practice referred the following recommendations, made by Mr. J. J. Hennessey, master car builder of the C. M. & St. P. Railway, to your committee for consideration:

"I beg to submit the suggestion to amend the M. C. B. specifications for M. C. B. couplers, so as to admit as M. C. B. standard couplers having the underneath uncoupling arrangement. Hundreds of thousands of this type of coupler are now in use, and their use is being extended by additional roads adopting same. By referring to M. C. B. coupler specifications, page 728 of the 1910 Proceedings, paragraph 4, reads as follows:

" 'Couplers must conform to M. C. B. standard drawings and contour line. The lock lift must be in the central longitudinal vertical plane of the coupler located between the striking horn and contour line and must operate from the top by an upward movement.'

"Reference to the M. C. B. standard drawings of the M. C. B. coupler, we find the following note:

" 'All couplers must have $1\frac{1}{16}$ inch eyelet for locking device located immediately above the locking pin hole.'

"The above are the portions of the specifications which prohibit the underneath uncoupling arrangement of M. C. B. coupler from being considered as M. C. B. standard."

Your committee has considered this matter and would recommend including in the standards the operation of lock from the bottom in addition to the present top lift, which requires the following changes in the standards:

Page 624, 1911 Proceedings, sixth paragraph, change to read:

"That all top-lift couplers must have a $1\frac{1}{16}$ inch eyelet for locking device located immediately above locking pin hole."

Same change to be made in note on Sheet M. C. B. 23.

Page 628, 1911 Proceedings, first paragraph, change to read:

"The lock lift must be in the central longitudinal vertical plane of the coupler located between the vertical plane of the striking horn and contour lines, and must operate either from the top or bottom by an upward movement. The total lift of locking pin shall not be more than 6 inches."

2. The attention of your committee has been directed to a discrepancy in dimension shown on Sheet M. C. B. 23. Since the introduction of the 9¼ inch and 12¼ inch heads the distance from the pulling face of knuckle to the buffer block or end sill as now shown on Sheet M. C. B. 23 is only correct for the original 8¾ inch head. As this dimension varies in accordance with the length of head and amount of compression in draft gear it is of no special value, and, therefore, would suggest that the Secretary be authorized to eliminate this dimension from Sheet M. C. B. 23.

In conclusion, your committee desires to express its thanks to the various railroads visited by the subcommittee for the courteous treatment accorded and the facilities extended them in making their investigations. The association is also indebted to the railroads previously enumerated for the couplers which were donated for test purposes and to the Pennsylvania Railroad in particular for the large number of couplers donated and for the facilities and expert assistance given in testing these couplers.

(Signed)

R. L. Kleine
F. W. Brazier,
J. F. DeVoy,
Henry La Rue,
F. H. Stark,
H. C. Trimyer,
G. W. Wildin,

Discussion.

C. A. Schroyer: I move that the committee be continued and a vote of thanks tendered them. This motion was carried.

C. A. Seley: I move that the recommendation as to changes be submitted to letter ballot. This motion was carried.

A report on Joint Inspection and Inspection Bureaus was distributed to the members.

CAR TRUCKS.

The chairman of this committee had been sick and no report was received from it.

SPRINGS FOR FREIGHT CAR TRUCKS.

The committee can present only a progress report.

Springs now used under freight cars take permanent set, have too little range of deflection, and sometimes break in service.

Some manufacturers are preparing to make experiments to develop a scheme involving the use of more reliable material and more uniform temper, but to date these experiments have not progressed sufficiently far for positive recommendations.

The indications are that relief will be obtained by heat treatment of steel and careful tempering, which will permit the use of higher allowable stresses when springs are compressed solid.

The steel at present used has about one per cent carbon, and when springs are compressed solid the stress is between 80,000 and 85,000 pounds per square inch. With carefully tempered, heat-treated steel, this stress can be increased to 100,000 pounds per square inch, and possibly to 120,000 pounds per square inch without producing permanent set or breakage, and the resultant decrease in diameter of wire will give a greater range of deflection within the limited space now available in trucks.

Better tempering of the steel now used can be obtained, and should be required. To avoid obtaining the springs either too hard or too soft, a specification for physical test is necessary.

Attention was directed to the impossibility of making the spring caps, shown on Sheet H, of ⅛-inch material without change in the central depression.

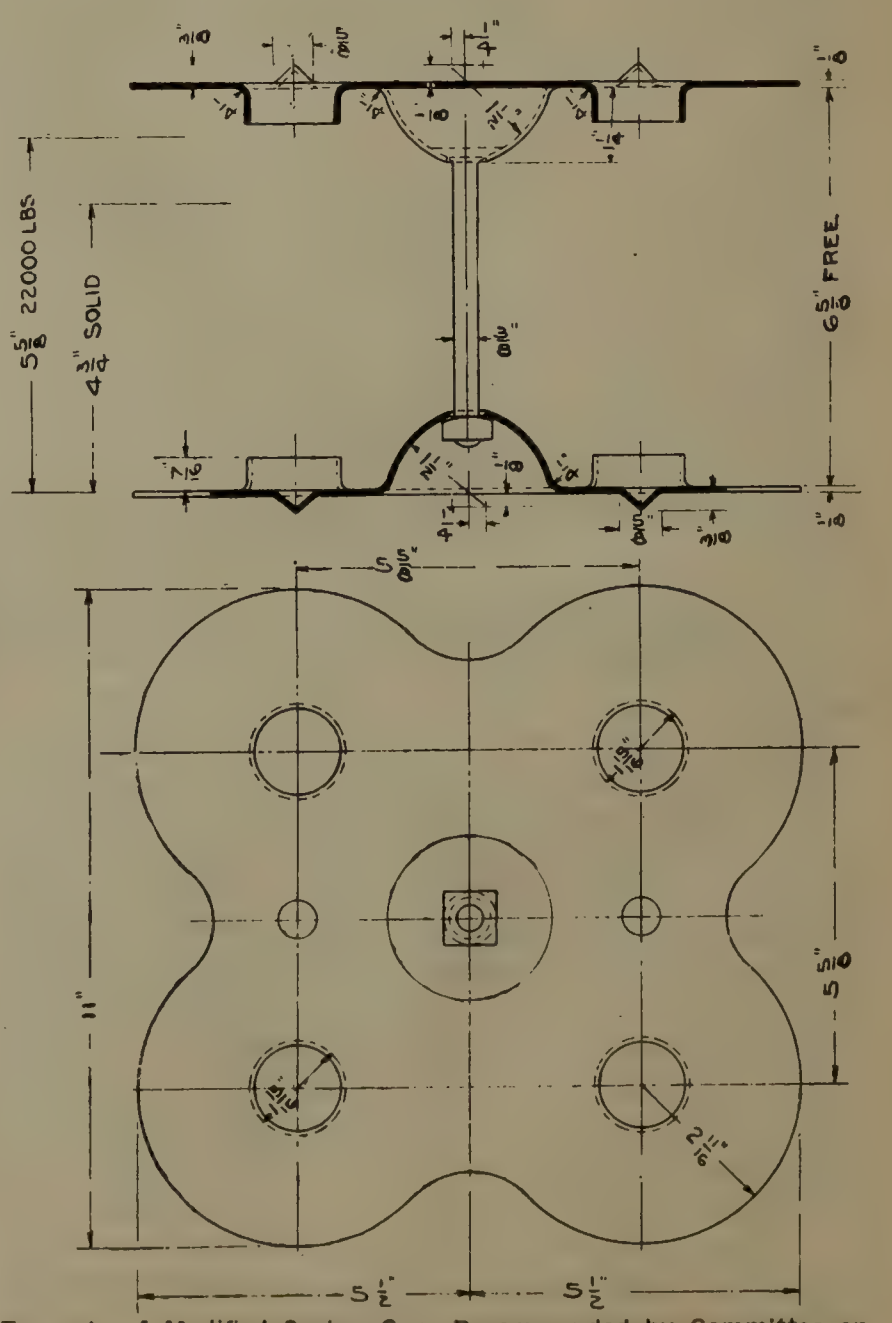
In view of the situation as described above, your committee recomends that no changes be made at this time in the design of the springs; that the design of the spring caps be modified, as shown in the drawing:

That the committee be furnished with dimensions of available space, or preferably prints of springs which have been designed for 140,000-pound capacity cars, for consideration in connection with making an M. C. B. design for such springs. As an example, an illustration of a spring used for that purpose is shown.

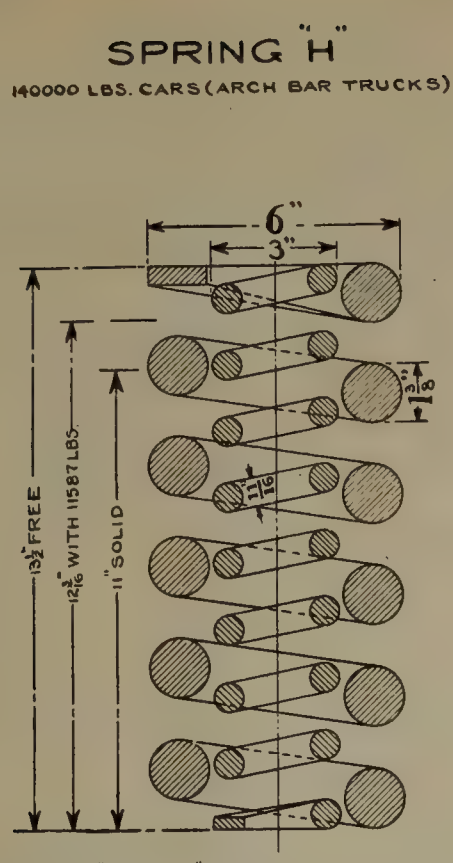
These can be used either with or without spring caps.

That before assembling, the springs meet the following physical test:

1. Every coil of each spring must be compressed solid with shock not less than six times.
2. At least ten per cent of each kind of coils must be weighed and measured.
3. The weight of each coil must not be less than the minimum weight specified.
4. The outside diameter of coil must not vary more than $\frac{1}{16}$-inch above or below the given dimension



Example of Modified Spring Cap, Recommended by Committee on Springs for Trucks.


SPRING "H"
140000 LBS. CARS (ARCH BAR TRUCKS)
6"
3"
13½" FREE
12 3/16" WITH 11587 LBS.
11" SOLID
2 1/8"
1 11/16"
TWO BARS, 1ST BAR 1⅜" DIA 116¼" LONG, TAPERED TO 123½"
2ND " 1 11/16" " 116¼" " " " 119⅞"
NORMAL WT 1ST " 48 LBS. 12 OZ MINIMUM WT 47 LBS 5 OZ
" 2ND " 12 " 3 " " " 11 " 13 "
OUTSIDE DIA. 1ST COIL 6", 2ND COIL 3"
HEIGHTS 1ST COIL 13½" FREE, 11" SOLID 12 3/16" 9270 LBS CAPY 17656 LBS
" 2ND " 13½" " 11" " 12 3/16" 2319 " " 4414
CLUSTER OF SPRINGS
HEIGHTS 13½" FREE. 11" SOLID. 12 3/16 11587 LBS CAPY 22070 LBS.

Example of Spring Suggested by Committee on Spring for Trucks.

5. The free height must not exceed, but may be less than the given dimension.

6. The load height must not be less than, but may exceed the given dimension.

7. If any coil of the ten per cent selected does not meet these requirements all coils of the same kind must be checked, and those which do not meet the requirements for weight and dimensions must be rejected.

The committee believes that the adoption of these preliminary rules will tend to give some relief from spring troubles, pending the development of better material and tempering.

(Signed)

W. F. Kiesel, Jr.,
T. A. Lawes,
J. R. Onderdonk,
J. Hainen.

Discussion.

F. W. Brazier: I move that the report be accepted and referred to letter ballot. Mr. Brazier's motion was carried.

CONSOLIDATION.

As the executive committee had not looked into the legality of this matter, the committee was continued for another year.

TRAIN LIGHTING.

The committee has gone over carefully the suggestions as to recommended practices given in our report to the 1911 convention, and have also given careful consideration to the various points as brought out by the Committee on Standards of the Association of Railway Electrical Engineers at its 1911 convention, and desire to change our suggestions as to recommended practices given in our report of 1911 to read as follows:

General.

1. That in electrically lighted cars the following voltages should be used:

60 volts (nominal) for straight storage, head-end and axle-dynamo systems.

30 volts (nominal) for straight-storge and axle-dynamo systems.

2. That each electrically lighted car be provided with a notice giving the following information, and that this notice shall be posted in the switchboard locker.

*System.
Type of generator.
Type of regulator.
Voltage of system.
Ampere hours capacity of battery at 8-hour rate.
Number of sets of battery in parallel.
Nominal charging rate ..... amps. ..... max. amps.
Size of train line wires — B. & S.
Number of train line wires — (2 or 3).
Capacity of generator ..... amps.
Axle pulley ..... in. diam.
Generator pulley ..... in. diam.
Length of belt ..... ft. ..... in.
Wiring diagram (show location and capacity of fuses).

*State whether axle dynamo, straight storage, and if used on head-end system.

3. That the rules of fire underwriters shall cover all car wiring.

4. That all wiring under car to the switchboard shall be run in conduits.

5. Standard lamps for car-lighting service should be in accordance with dimensions as shown on Exhibit L.

6. That where train-line connectors are used, a connector having dimensions as shown on Exhibit A shall be used and located as shown on Fig. 1, with connections to dynamo, battery and jumper as shown on Fig. 2. If only two wires are used they shall be connected to the outside terminals and the female connector on each end of the car shall be stenciled: "Not for use on head-end system."

7. That each electrically lighted car equipped with batteries shall be provided with two charging receptacles with swivel supports, as shown in detail on Exhibits B, C and D, installed one on each side of the car as shown on Exhibit E, the outside annual ring to be the positive.

Control and Protection of Parts.

8. That each electrically lighted car shall be provided with a switchboard upon which shall be mounted switches, fused switches or terminals. The switches, fuses or terminals to protect and completely disconnect the following parts:

(a) Train line.
(b) Battery.
(c) Axle dynamo.
(d) Circuits for lamps, fans, etc.

The axle-dynamo terminals to control the positive and negative armatures and the positive field of the dynamo. Each of the above switches, fuses or terminals to be plainly marked, designating the part controlled, the positive terminal to be on the right side facing the board.

9. Where a main lamp switch is used, or where fuses controlling all lamps are used, they shall be so stenciled in plain letters.

10. The switchboard or regulator panels of electrically lighted cars shall be provided with fuses for the protection of the parts given below and with the type of terminal as specified.

(A) Train Line.—Terminals for reception of flat fuses shall be provided 2½ inches between centers; stud or screw to be —— in. diam., with —— threads per inch.

(B) Battery.—Optional. Fuse terminals, if used, shall be same as for train line.

(C) Main Line Switch. Optional. Fuse terminals, if used, shall be same as for train line.

(D) Circuits.—For lamps, fans, etc., fuse shall be of the Edison screw-shell type for both positive and negative.

(E) Axle Generator.—Postive armature fuse terminal; terminals to have N. E. C. code standard 150 amperes knife blade contact clips mounted with 4-inch clearance between clips.

(a) Axle Generator-Negative armature fuse terminal optional. If used, terminal shall be same as positive.

(b) Axle Generator.—Postive field optional. If used, to have ferrule type clip mounted with 1-inch clear space between clips and to take N. E. C. code standard, 0 to 30 amperes.

11. That each electrically lighted car equipped with battery box or boxes shall have provided a fuse block, mounted in a suitable metal box at the positive and negative terminals of each set of batteries, and that the fuse block shall be in accordance with the detail as shown on Exhibit F, and installed on the car substantially as shown on Exhibit E. Knife-blade fuses shall be provided with a capacity of between 101 and 200 amperes.

12. That where axle dynamos are used, negative, positive and dynamo field shall be fused as close as possible to the dynamo and prior to the said leads either entering the conduits or being secured to the bottom of the car. The above fuses to be used for emergency service only and to be at least one hundred per cent above the capacity of the fuses on the switchboards protecting the same leads.

13. All wires or terminals must be marked for identification.

Batteries.

14. That batteries as a set shall be connected up with a positive pole to the right, facing the car as shown in Fig. 2.

15. Where lead storage batteries are used they shall be preferably installed in double compartment tanks substantially as shown of Exhibits G, H and I.

16. That where double compartment tanks are used, the connections and arrangements of battery terminals are to be as shown on Fig. 3.

17. Battery boxes shall have provided in each door a vent, substantially as shown on Exhibit K.

Axle Dynamo.

18. That a straight pulley seat be provided for the axle pulley. That if a bushing or sleeve be used it should preferably be secured to the axle, independent of the pulley. Bushing to have an external diameter of 7½ inches and to be 8½ inches long, turned straight. That the pulley hub have a uniform internal diameter of 7½ inches, the length of the hub to be 6½ inches, the face of the pulley to be 9 inches or wider if flangeless, and 8 inches if flanged. That

Note.—Capacity of fuses, as designated above, to be such as to properly protect the parts in question.

the generator pulley be flanged, crowned and perforated, and have a 7-inch face.

19. That when facing the end of the truck on which axle generator is mounted, the pulley or sprocket shall be on the right-hand side.

In the above the following changes have been made from the recommended practices as given at the 1911 convention.

The information originally shown on Exhibit A has been incorporated in the body of the report and the following items added to recommended practice:

Item No. 2—Type of generator.
Type of regulator.
Voltage in place of number of cells and series.
Size of train-line wires.
Number of train-line wires.
Capacity of generator.
Length of belt.

The following items being omitted:
Cut in voltage.
Amperes no light.
Amperes full light.

Item No. 5—Added.

Item No. 6—The principal dimensions of Gibbs No. 3-G. train-line connector have been shown on Exhibit A, and reference to the specific type of connected omitted from the body of the report.

Item No. 8—Item D, covering circuits for lamps, fans, etc., has been added and the reading slightly changed.

Item No. 10—Details covering type of fuse terminals have been given.

Item No. 11—Item has been changed so as to provide for a fuse at the positive and negative terminals of each set of batteries and fuses specified with a capacity of between 101 and 200 amperes in place of 150 amperes.

Item No. 13—Added.

Item No. 14—The words "as a set" have been added after the word "batteries," first line.

Item No. 15—Has been changed so as to cover only lead batteries.

Item No. 17—The word "substantially" added.

Item No. 18—The word "preferably" has been added in the second sentence.

Exhibit A—Canceled, the information being shown in the body of report and new Exhibit A made showing principal dimensions of recommended train-line connector.

Exhibit E—Detail of fuse box crossed off; dimension of center line of charging receptacle to the needle beam omitted. Sketch added showing arrangement of fuses with two batteries in parallel.

Exhibit F—Detail of fuse box removed, showing only details of fuse block and clip.

Exhibit G—Detail of battery terminal connectors omitted. Hole omitted at handle plate.

Exhibit H—Detail dimensions of plates slightly changed. Redesign of bridges shown.

Exhibit I—Detail of handle changed and detail of battery terminals omitted.

Exhibit K—Part of note covering application of copper screen to vent, cut out.

Exhibit L—Standard train-line lamps added.

In addition to the above report on recommended practices your committee desires to make the following suggestions to the Association for consideration:

(1) The adoption of standard size straight axles for different journal sizes for use with axle dynamos. This in view of the adoption of the axle device throughout the country, and the fact that with the present standard tapered axle it is very difficult to properly secure the axle pulley or bushing. The straight axle would result in less maintenance cost in axle pulleys and belts and improvement in service. A number of roads have adopted the straight axle, and if this practice spreads, the diameter of the axle should be standardized in order to minimize the different sizes of bushings or pulleys for car-lighting equipment.

(2) The design and adoption of standard arrangement of axle-dynamo suspension; the axle-dynamo people arranging to provide necessary lugs so that their dynamos will be applicable to the M. C. B. standard suspension. This suggestion is made in order that a safe suspension may be provided for all equipment and that the generators as manufactured by the various manufacturers will be interchangeable.

(3) If the train-lighting committee is continued, the committee would like to be advised as to whether or not it is desired that they include in their investigation recommended practices as to maintenance and repairs of batteries and other electric-car lighting apparatus, and maintenance and repairs of axle generators.

(Signed)
T. R. Cook,
C. A. Brandt,
Ward Barnum,
J. H. Davis,
E. A. Benson,
D. J. Cartwright,
E. W. Jansen.

Discussion.

C. A. Seley: I move that the report be accepted and, with the exception of the last three suggestions, be referred to letter ballot. The three suggestions to be referred to the executive committee.

R. L. Kleine: I wish to amend by having the report referred to letter ballot by items.

The motion as amended was carried.

FRIDAY, JUNE 14.

The meeting was called to order by President Stewart, and after the appointment of tellers for the election, the association listened to a paper on Car Shop Apprentices, by I. S. Downing, of the Lake Shore & Michigan Central, which will appear in the August issue of the *Railway Master Mechanic.*

A vote of thanks was extended to Mr. Downing for his paper. Mr. W. C. A. Henry arose and on behalf of Mr. Crawford, who was absent, withdrew his name as a candidate for president of the association; however, he allowed his name to stand as a candidate for vice-president.

TRAIN PIPE AND CONNECTIONS FOR STEAM HEAT.

In its 1911 report the committee recommended the following recommended practices be advanced to standards:

1. Two-inch train line.
2. End steam valves, with not less than 1½-inch openings.
3. Location of steam, brake and signal pipe, as shown on Print A.

Recommended for adoption as recommended practice:

1. Nipple, as shown on Print B.
2. Steam hose, as shown on Print D.
3. Hose clamp, as shown on Print E.
4. Each end of hose to be fitted with nipple, as shown on Print. B.
5. Coupler to have not less than 1½-inch opening. The horizonal elevation of nipple to opening through coupler is: minimum, 15 degrees; maximum, 20 degrees; coupler to be tapped with 1½-inch pipe thread as shown on Print F. Couplers were considered, but no recommendations were made.

The committee sent out a circular of inquiry, under date of August 14, 1911.

From data received from replies to circular and investigation during the past year, the committee makes the same recommendations, except recommendations for Recommended Practice No. 5.

In regard to couplers, your committee finds a very large number of roads using the so-called large coupler with 1½-inch full-opening gasket, and equally, if not a larger number, using the medium size with 1⅜-inch full-opening gasket, and a very small number using the small coupler with 1¼-inch full opening. The latter your committee did not consider, in view of the fact that the roads using the large size claim they can not operate their long trains successfully with gasket opening less than 1½ inches, and your committee being unable to agree on a coupler, we beg to submit two couplers for the consideration of the Association. Couplers shown on Print G, the coupler shown as medium coupler with 1⅜-inch can be made to take 1½-inch full-opening gaskets. These couplers are not interchangeable. The question for the association to decide will be between the heavy coupler with 1½-inch gasket and medium size coupler with 1⅜-inch or 1½-inch full-opening gasket. Your committee made service test of hose to determine the proper angle of nipple with opening through coupler. We fitted up an equal number of hose manufactured by the same company. The angle on half of couplers was 20°; the other half was 45°. At the end of test the hose were examined, and there was practically no difference in condition of hose. While there is no difference in service of hose by using the larger angle, it is possible to use hose 2 inches shorter, thus effecting quite a saving in hose. We have also considered specifications for steam hose, and submit herewith specifications. Copies of same have been submitted to the manufacturers, and their criticisms are given herewith.

Recommendations for Standards.

Your committee would recommend that the following be submitted to letter ballot for adoption as standards in the association:

1. Two-inch train line.
2. End valves with not less than 1½-inch opening.
3. Location of steam, air and signal pipe as shown on Print A.

The committee would recommend the following be submitted to letter ballot for adoption as recommended practice of the association:

1. Nipple as shown on Print B.
2. Steam hose, five-ply, 1½ inches inside diameter, as shown on Print D.

Note—Length to be omitted until the association has adopted a coupler showing the standard angle.

3. Hose clamp as shown on Print E.
4. Each end of hose to be fitted with nipple as shown on Print B.
5. Specifications for steam hose as per attached.

Proposed Specifications for Steam-Heat Hose.

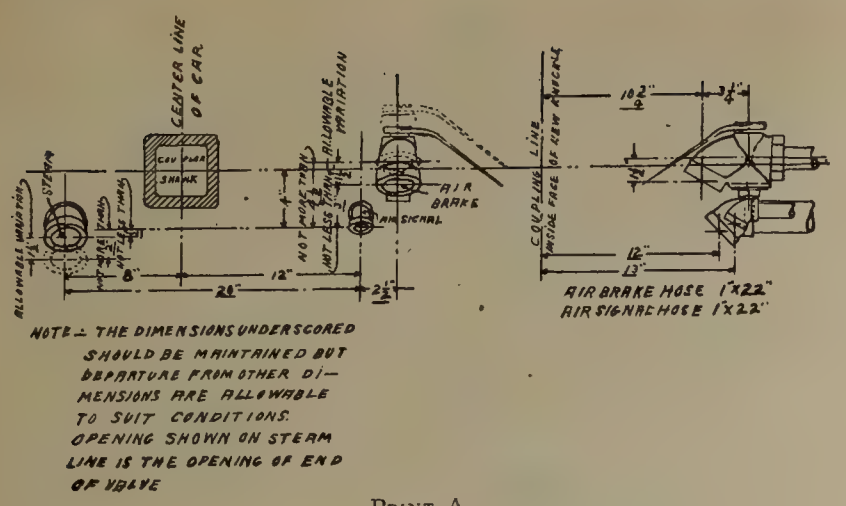
1. Steam-heat hose must be composed of a tube of rubber, wrapped with 5-ply cotton fabric and the whole covered with rubber.

2. The tube must be hand-made and composed of three calenders of rubber, the middle calender being of a color so much different from the others that the three may be easily distinguished. It must be free from holes, bits of wood, bark, sand and other foreign matter, and from other imperfections. It must be so firmly joined to the fabric that it cannot be pulled off without tearing it. It must be free from rubber substitutes.

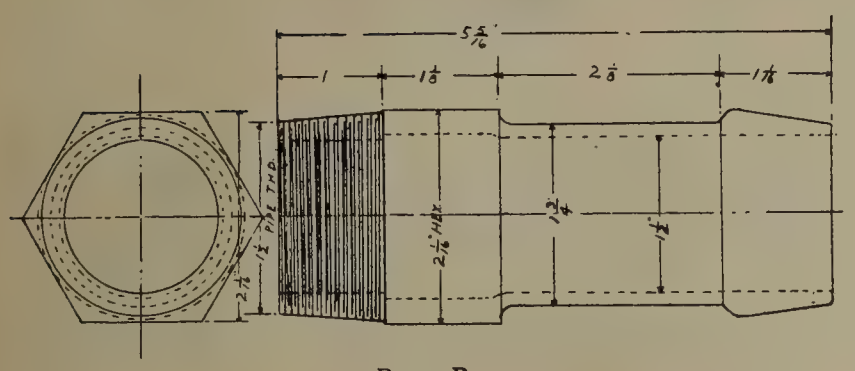
3. The fabric must be of duck, made from long-fiber cotton, loosely woven, and weighing not less than 20 ounces per square yard; it must be frictioned on both sides and have, in addition, a distinct layer of rubber on one side, readily visible between the plies when the finished hose is cut open.

4. The cover must be as securely attached to the fabric as is the tube, and be equally free from defects.

Both ends of the hose must be covered with caps of rubber,


CENTER LINE OF CAR
AIR BRAKE
AIR SIGNAL
COUPLER LINE
INSIDE FACE OF KNUCKLE
AIR BRAKE HOSE 1"x22"
AIR SIGNAL HOSE 1"x22"
NOTE — THE DIMENSIONS UNDERSCORED SHOULD BE MAINTAINED BUT DEPARTURE FROM OTHER DIMENSIONS ARE ALLOWABLE TO SUIT CONDITIONS.
OPENING SHOWN ON STEAM LINE IS THE OPENING OF END OF VALVE

PRINT A



PRINT B.

securely vulcanized on in such a manner as to form a continuous member with the tube and cover.

5. Labels. Each piece of hose must have securely vulcanized to it a label of white or red rubber, as shown below. The letters and figures must be ¼ inch high and stand in relief at least $\frac{1}{32}$ of an inch. Each lot of 200 pieces of hose or less must bear the manufacturer's serial number, beginning with 1 on the first of each year and continuing consecutively until the end of the year. Serial numbers of hose which are rejected must not be used again. With each lot of 200 hose or less, one extra piece must be furnished, free of cost.

(For form of label, see Print D.)

6. Dimensions.

	Minimum, Inches.	Maximum, Inches.
Length	23¾	24¼
Inner diameter	....	....
Outer diameter	....	....
Thickness of tube	⅛	.....
Thickness of cover	$\frac{1}{16}$	....
Thickness of end caps	$\frac{1}{16}$	⅛

7. Tests. The railway company's inspector will select for test one piece at random from each lot of 201 pieces, and will subject it to the following tests:

A. Friction test. A section 1 inch long will be cut from the hose and supported in such a manner that it will turn freely on its axis. A 25-pound weight will be suspended from the separated end of the fabric. The latter must unwind uniformly, if at all, and not faster than 8 inches in ten minutes. This test may be made at any point in the strip of fabric.

B. Stretching test. One-inch-wide strips of both tube and cover will be marked at points 2 inches apart and stretched until the marks are 8 inches apart, and immediately released and remarked at 2 inches. The pieces will then be stretched until the second marks are 8 inches apart and held thus for ten minutes, then released, and at the end of ten minutes more the distance between these marks will be measured. This distance must not exceed 2⅛ inches. If the strips break or develop holes extending clear through their thickness during this test, they will be considered to have failed.

C. Tensile test. A 1-inch-wide strip cut from the tube will be marked at points 2 inches apart and the width and thickness will be accurately measured. It will then be slowly stretched in a suitable tensile testing machine until it breaks. The ultimate tensile strength must not be less than 500 pounds per square inch, and the elongation at fracture must not be less than 400 per cent of the original length.

D. Steam test. The remainder of the sample will be suitably mounted on nipples and will be subjected to dry, saturated steam at 50 pounds pressure for four days of eight hours each, the steam being shut off over night. The cover must not develop any holes or cracks, and the hose must not leak at any point during this test. At the end of the test period the hose will be allowed to cool for sixteen hours, and the friction, stretching and tensile tests will be repeated. The deterioration thus indicated must not exceed 30 per cent of the figures obtained from the original sample.

E. Pressure test. If desired by the railway company, the piece remaining from the steaming test may be subjected continuously to dry, saturated steam at 100 pounds pressure for 200 hours, which it must stand without bursting.

8. If the sample fails to pass the above tests, the lot represented by it will be rejected, and the same serial number must not be applied to any other steam hose during the same calendar year. If the sample passes all of the tests, all pieces represented by it will be accepted if free from injurious mechanical defects.

Rejected hose will be returned at the expense of the manufacturer.

Criticisms on Specifications From the Manufacturers.

2. I presume the object of requiring a middle calender of different color is to prevent the manufacturer from making the tube on a tube machine. Is there any definite proof that a tube run on a tube machine is not as serviceable as a calendered one? It seems to me that if the tube meets all the tests, that is all that is necessary, and such small points of construction should be left to the manufacturer.

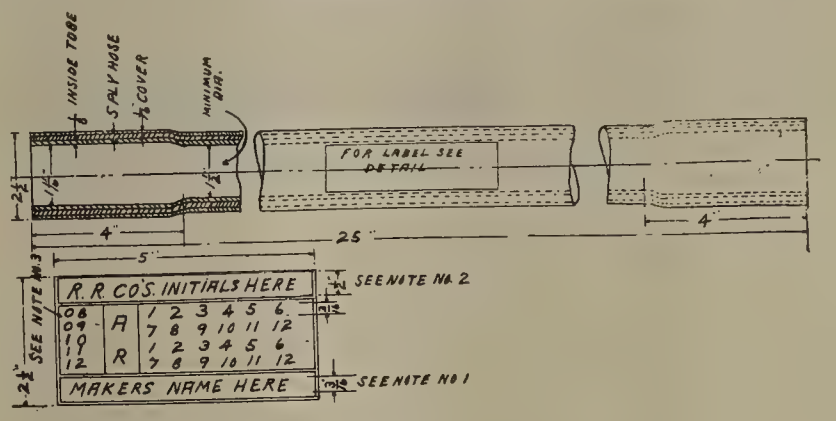
It is hardly necessary for a tube to be so firmly joined to the friction that it tears when being separated. If this were the case, it would be difficult to obtain a test piece for tests given later in the specifications. An adhesion equal to that called for in the friction test would be sufficient.

7. (A) I would consider a 20-pound dead-weight test sufficient. A 25-pound friction increases the cost of the hose, without any particular advantage in service.

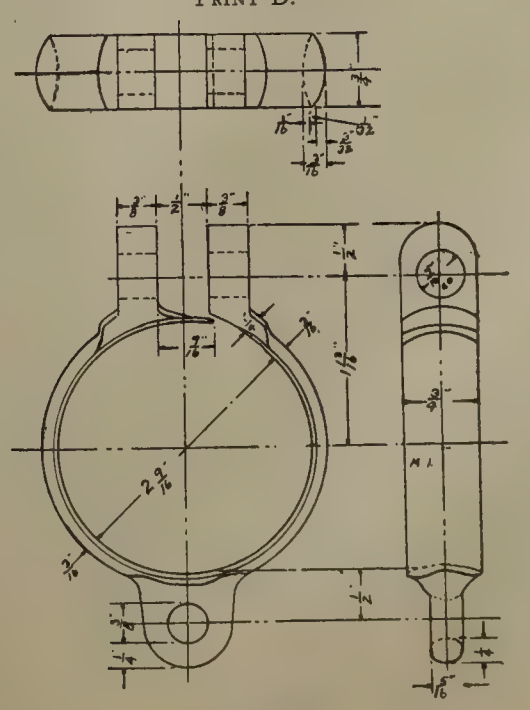
(B) A stretching test is seldom made on steam hose, for the reason that compounds which best resist the action of steam do not take a great stretch or have a small set. I see no advantage but a decided disadvantage in this test to insure good steam-resisting hose.

(C) It is difficult to obtain an accurate tensile on a straight 1-inch strip. A much more accurate tensile can be obtained on a ½-inch piece cut with a die made for the purpose which is wider at the ends where the piece fits into the jaws of the tensile machine. A low tensile and big elongation will give a soft piece of rubber unfit for resisting steam. Good steam-resisting compounds usually have a tensile higher than 500 pounds and elongation less than 400 per cent.

(D) Not enough detail is given in any of the tests given above,


INSIDE TUBE
PLY HOSE
COVER
MINIMUM DIA.
FOR LABEL SEE DETAIL
R. R. CO'S. INITIALS HERE
SEE NOTE No. 2
MAKERS NAME HERE
SEE NOTE No. 1
NOTE —
No. 1 - MANUFACTUERS' NAME TO BE PLACED IN THIS SPACE IN ¾" LETTERS
No. 2 - RAILROAD COMPANIES INITIALS WILL BE FURNISHED WITH INDIVIDUAL ORDERS.
No. 3 — THE FIRST FIGURE IS TO BE THE YEAR WHEN HOSE IS MADE FOLLOWING FIGURES ARE TO BE SUCCESSIVE YEARS

PRINT D.



PRINT E.

leaving too much room for misunderstanding. Much more should be said as to what is meant by 30 per cent deterioration on the different tests. In the after-steaming friction test is the deterioration to be figured from the decrease in weight that will pull as much as the 25-pound weight did before steaming, or will the increased number of inches the 25-pound weight pulls after steaming be used to figure the deterioration? How would you figure the deterioration on the stretch and set test? Such points should be made clear in the specifications.

(E) A rather severe test.

8. No comment.

In these specifications, and in most rubber-goods specifications in general, not enough details are given as to the exact method of carrying out the tests. In your own interests, you should eliminate from your testing methods the factor of personal equation and possibility of misunderstanding. Inasmuch as is possible, your specifications should be so worded that there can be no doubt as to how the test is to be carried out and what result is expected or demanded for approval. You should eliminate from specifications things about which there are no data to prove their value—in other words, the test should require no property of the material, the value of which is not known. You should specify physcial properties which have a definite bearing upon the quality of the article. The design and use to which the article is to be put should in every case determine the nature and severity of the test. A good factor of safety should be arranged for, but there is absolutely no need for a test four or five times as severe as the article gets in actual service.

(Signed) C. A. Schroyer.
W. C. Arp.
J. J. Ewing.
I. S. Downing.

Discussion.

Mr. Downing stated that the committee had been unable to agree on a coupler.

Henry La Rue: I would like to know the reason for the new location of the air and signal pipes. There seems to have been a change of an inch and a half.

I. S. Downing: The hose is in the same location, but we thought it better to show the center line of the car than that of the shank.

W. E. Dunham: The air brake line ought to be at an angle of 20 degrees as with freight equipment. This should be changed before making it standard. As regards the nipple shown in the figure, I believe that few roads consider this a good nipple, and I do not think it a good one to adopt at this time. These remarks also apply to the clamp shown in Print E.

C. D. Young: The hose shown in Plate D has enlarged ends. There would be a difference in diameter of $\frac{3}{16}$ of an inch. I think that a straight hose is to be preferred to one with large ends. No provision has been made on the badge plate for the manufacturer's serial number or for the letters M. C. B. With respect to Print E, we have found it necessary to use a two-piece clamp. We have not had very satisfactory experience with a five-ply hose, and have found the six-ply gives much better service on high pressure lines. I believe that the duck should be standardized. I note in the specifications that the duck is to be 20 ounces to the square yard and would like to ask how this is to be measured. Different manufacturers use different numbers of strands with different numbers of threads per strand. I would recommend that the specifications be changed so as to give the strands per inch, threads per strand and the load. With respect to the friction test given in paragraph 7-A, if the section is taken where the large end comes down to a small diameter, it will be impossible to have any friction tests, as there will be no strength at a place where the duck is stretched over two diameters. In Section B would suggest that it be changed to read "not faster than six inches in 10 minutes," instead of eight. With regard to Section C, calling for test pieces one inch wide, would recommend that enlarged ends be used for testing purposes. In Section D, I would like to know how the 30 per cent deterioration is to be measured. Is it meant to take 30 per cent for weight, 30 per cent for distance and 30 per cent for time, or only one of these? In Section E, I would recommend that "100 pounds pressure for two hundred hours" be changed to 300 hours. I recommend that this be referred back to the committee.

L. S. Downing: We cannot argue this matter with Mr. Young as we are not expert in this line. Would say that there was a Pennsylvania man on the committee, but he did not attend any of the meetings. However, we had a number of experts to work with us. I should like to have this referred back to the committee and would also be glad to have Mr. Young as a member.

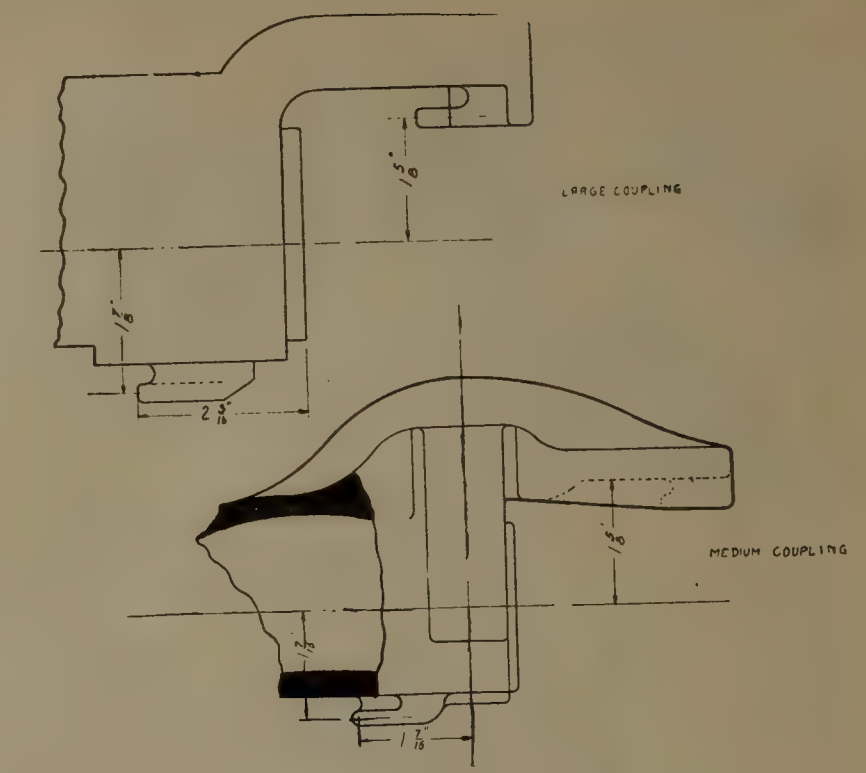
Henry La Rue: I see no reason for changing the angle of the angle cock.

C. A. Schroyer: We can't show the angle to any degree of accuracy. If we find the hose interfering with each other we turn the angles to meet requirements. With regard to hose specifications, would say that we cannot get very much worse hose than we are getting today, and I think we ought to use the specifications presented as a basis from which to work. We have always indicated duck by the ounce, and we all know that if we specify 20-ounce duck the manufacturers will give us 20-ounce duck.

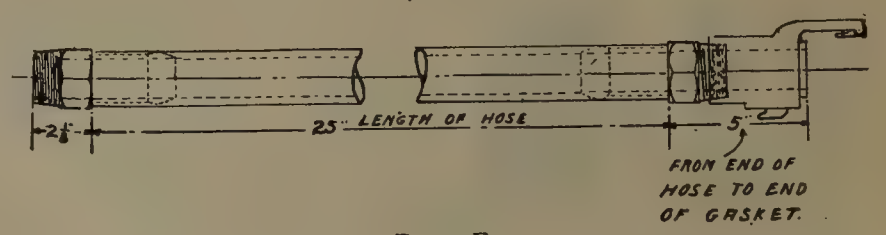
C. D. Young: The specifications given are better than any we have had, but I wish to emphasize the fact that we must have certain information and specifications for use in the testing laboratory. I think it would be a good thing to let this go to letter ballot and consider the specifications which I have proposed next year.

F. F. Gaines: I move the report be adopted and the specifications be referred to letter ballot.

Mr. Young accepted this amendment and the motion was carried.



PRINT G



PRINT F.

S. B. Andrews: With regard to the label specification in paragraph 5, would suggest the word "raised" be used in place of the word "stand," and that it read "raised in relief at least $\frac{1}{32}$ of an inch."

TANK CARS.

The tank car committee herewith submits a revision of the existing tank car specifications.

This revision was primarily brought about by the growth in shipments of products which were not handled in tank cars at the time when the original specifications were drawn. It has been considered advisable to also rearrange the order of the paragraphs of the specifications, so as to make it more logical.

Since the original specifications were drawn the great increase in the shipments of naphthas has been a very marked feature of the tank-car business; and within the last four or five years a new product, known under various names, but principally as "casing head naphtha," has been developed and is now offered for shipment in tank cars.

This product is obtained through the compression, cooling and subsequent expansion of natural gas, which yields a very volatile product, of undoubted value, but also presenting special problems when handled in tank cars. A description of the product will be found under the head of "Liquefied Petroleum Gas," on page 35 of the Report of the Chief Inspector of the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles, February, 1912; also in Technical Paper No. 10, Bureau of Mines, Department of the Interior, entitled "Liquefied Products from Natural Gas," and therefore it need not be further described here.

The raw product, especially that from certain of the gas fields, is entirely too volatile to be shipped, and consequently it is subjected to a partial evaporation, known as "weathering." The resultant liquid, after the evaporation of some of the lighter products, is what is offered for transportation.

This natural gasoline, as shown by the records of the tests which will be described later in this report, showed a sudden mounting in pressure when the tank was exposed to the flame, the gas catching fire and burning above the safety valve. Generally it will be noted that the time interval from the lighting of the fire to the initial blowing of the safety valve was very much less with the natural gasoline used than with the refinery gasoline.

When the original specifications were drawn none of the products which were shipped in tank cars showed high vapor tension at the ordinary temperature of transportation, and the setting of the safety valves at eight pounds was considered ample to prevent the escape of the liquid in a gaseous form, and at the same time it was shown that it relieved the cars of any dangerous pressure, even in the event of a fierce fire.

The new products have developed a very much higher vapor tension at ordinary temperatures, and the Interstate Commerce Commission has provided for the transportation of such products by a rule reading:

Group 2—Inflammable Liquids.

"Rule 1824. All inflammable liquids in this group must be shipped in . . . or in tank cars, provided the vapor tension of the inflammable liquid corresponding to a temperature of 100 degrees F. (90 degrees F. November 1 to March 1) does not exceed ten pounds per square inch."

"Liquefied petroleum gas is a condensate from the 'casing head gas' of petroleum oil wells, whose vapor tension at 100 degrees F. (90 degrees F. November 1 to March 1) exceeds ten pounds per square inch. Liquefied petroleum gas must be shipped in . . . . or in tank cars especially constructed and approved for this service by the Master Car Builders' Association. When the vapor pressure at 100 degrees F. exceeds twenty-five pounds per square inch, cylinders, as prescribed for compressed gases, must be used."

The producers of this product petitioned for a safety-valve setting of twenty-five pounds, complaining of the excessive losses of the product when shipped in the ordinary tank cars.

Before agreeing to any change in existing tank cars, the Tank Car Committee felt that it was necessary to determine whether the safety valves as prescribed for the ordinary product were adequate to relieve tanks of the usual capacity when loaded with the new product.

It was decided that for this purpose a tank of greatly reduced capacity should be used, equipped with safety valves of reduced size, but of the same type as those used on the standard tank cars, and of a capacity as nearly as possible proportioned to the experimental tank.

The American Welding Company, Carbondale, Pa., offered to prepare a welded tank, similar in form to that of the cars, the shell, ends, and dome being all welded, the only cost to the Association to be that of the steel plate used, the tank to be returned to the makers after the tests. This tank, of which a drawing is shown herewith, was shipped to Follansbee, West Virginia, mounted on brick piers, and provision made for a gasoline fire underneath, very much as was done at Lima when the original specifications were framed.

Three safety valves, of which one was as nearly as possible of an estimated capacity comparative with that of the standard safety valve on the 6,000-gallon tank, one of an estimated capacity twenty-five per cent less, and a third having a capacity of twenty-five per cent greater, were prepared and furnished by the Crane Company, free of cost. The first two of these valves were those used in the tests.

The plan was to make fire tests with the same grade of oil that was used at Lima, and then with the new product from the gas wells, with the hope that the resulting pressures from the new product would be near enough to those developed by the refinery product to obviate the necessity for any modification in the requirements for safety valves, and to avoid the necessity of tests with full-size tanks.

The Atlantic Refining Company agreed to duplicate the material used in the original tests, record of which was in existence, and furnished without cost to the Association 1,600 gallons of gasoline, 66-degree Baume gravity, which was prepared as a close cut—in other words, the gravity was that of a fairly homogeneous liquid, rather than a blend of high and low values. This was very desirable, so as to maintain the gravity of the liquid fairly constant during the tests. This liquid will be alluded to hereafter as "refinery gasoline."

The condensed or casing head naphtha was obtained from the wells immediately around Follansbee, and varied both in gravity and vapor tension, as will be noted in the record of the tests.

Seven tests were made, viz.:

No. 1, refinery gasoline, No. 2 (normal) safety valve, 12-pound setting.

No. 2, casing head naphtha, same valve as No. 1, same setting.

No. 3, casing head naphtha, No. 1 (25 per cent less) safety valve, 12-pound setting.

No. 4, casing head naphtha, No. 2 safety valve, 20-pound setting.

No. 5, refinery gasoline, No. 2 valve, 20-pound setting.

No. 6, refinery gasoline, No. 1 safety valve, 12-pound setting.

No. 7, refinery gasoline, No. 2 safety valve, 12-pound setting. This was a repetition of Test No. 1, in which the burners were not working well, and the heat was not, consequently, as great as in the subsequent tests.

From the results obtained the committee believes that the present standard M. C. B. size of safety valve will fully meet the requirements and properly relieve the pressure when transporting gasoline of a gauge as high as 88 degrees Baume. This in view of the fact that the fires employed during the tests were probably more severe than those to which tanks would be exposed during fires resulting from accidents.

From the vapor tensions it is evident that casing head naphtha can not be even normally handled in the present tank cars with valves set at 8 pounds, and that even with the 12-pound setting there would probably be a loss of liquid through evaporation.

While the present type of tank car would better suit this business with all valves set at 12 pounds than with the present setting, where at least one valve is set at 8 pounds, nevertheless it is evident that for the economical handling of this particular grade of gasoline a higher setting is desirable.

Your committee feels, however, that rather than to allow the setting down of the valves on the existing tank cars, which aggregate between 35,000 and 40,000 in number, it is better to provide a special car for this particular product, and in doing so to provide for a setting of 20 pounds.

It is believed that the total equipment necessary to handle this entire business would be less than one per cent of the total tank-car equipment of the country.

While it is perfectly practicable to provide tanks which would be safe with very much higher pressures than 20 pounds, it is felt that it would be undesirable to do so, for the reason that in case of any injury to the tank in the course of transportation, the higher pressures would involve greater dangers in the handling of the cars, and therefore, for the present at any rate, the committee does not recommend any higher setting.

It is evident that any means which will retard the admission of heat to tank cars carrying such materials as casing head naphtha will probably prevent the attainment of the high temperatures which would be reached through the exposure of the naked tank to the summer sun. To determine this a final test was made at Altoona.

Taken During Test No. 4 With High Baume Gasoline. The Intensity of the Fire at the Valve and Opening of the Tank is Clearly Illustrated.

The same tank was employed, being lagged with 2 inches of magnesia, lagging, protected by a sheet-iron jacket. This tank was mounted again as at Follansbee, and filled with casing head naphtha having a gravity of approximately 87° Baume at 60° F. The valve used was No. 2, with 20-pound setting. The fire was obtained by small wood and kerosene.

In this test over two hours elapsed between lighting the fire and the appearance of any flame at the safety valve, notwithstanding the fact that about a half cord of wood and ten barrels of kerosene were used to maintain the heat under the tank during the test, which lasted about four hours.

The results of this test show that whereas with the naked tank the safety valve opened in about two minutes after the lighting of the fire, with the lagged tank it required two hours and twenty-two minutes; and that whereas with the naked tank the outage per minute amounted to as much as 114.6 pounds, with the lagged tank this was reduced to a little over 6.6 pounds, and it is probable that had the fire not been so severe as to burn through the sheet-iron jacket, causing part of the magnesia lagging to fall down, the outage would have been considerably less.

This leads to the conclusion that the high vapor tension naphthas should preferably be handled in special cars and that these cars should be lagged to reduce the absorption of heat; under which condition it is most probable that a vapor tension sufficient to raise the safety valve would never be reached.

The attention of your committee has also been called to the question of handling liquefied chlorine gas in tank cars. This material is used for the removal of the tin from tin scrap.

The number of tank cars in use for this purpose is small, and at the time our attention was called to the matter they were not equipped with any safety valves or relief of any kind.

The tanks are welded, and completely lagged, and the shippers, who are also the consignees, objected to the regular safety valve, owing to the fact that the liquid evaporates very sluggishly, that it is exceedingly objectionable when liberated, and that the gas is non-corrosive while dry, but very corrosive in the presence of water.

Various forms of safety valves have been submitted by the shippers, but have been rejected by the committee, for the reason that the setting of the valve could be controlled by a handle, so as to shut it off from action as a safety valve. The owners have

agreed, however, to provide a combination of safety valve and fusible plug which will insure tightness.

To settle the question of whether the tank would be relieved before it could reasonably be expected that the fusible metal would start, a test was made at the works of the Goldschmidt Detinning Company, Chrome, New Jersey, with a small-size tank.

The tank was 19 inches diameter inside, 6 feet 8½ inches long over all, with spherical heads, 19 inches radius; made of ¾-inch steel; all seams welded. It had a dome 12 inches diameter inside, 9½ inches high above steel of tank, made of cast steel, 1 inch thick, with cover of cast steel secured by bolts. The tank was designed for a working pressure of 300 pounds, and tested to 400 pounds per square inch. It was insulated by lagging with two 1½-inch layers of asbestos sponge felt and one 2-inch layer of vitribestos, covered with a sheet-iron jacket, the lagging being carried over sides, ends and dome.

The tank was filled to within a short distance of the top with 1,050 pounds of liquid chlorine, the gauges showing a pressure of 42 pounds per square inch, and an atmospheric temperature of 44° F. when the fire was lighted.

The log of the test is herewith, and shows that though exposed to a fire which was certainly as fierce as any which could be expected in a wreck, the exposure of three hours and twenty-six minutes raised the pressure to but 150 pounds, and the temperature to but 140° F.

The tendency with a full-size tank car would be to still further reduce the rate of pressure rise, owing to the fact that the cubic contents increase as the cube of the dimensions, whereas the heating surface increases but as the square of the dimensions.

The committee feels that from the results shown the probability of reaching a bursting pressure during the duration of an ordinary fire would be remote. Nevertheless, a combined safety valve and fusible plug, which the users of these cars are perfectly willing to apply, will be called for.

It is probable that from time to time other products, such as compressed oil gases, transported for buoy lighting, compressed oxygen gas for acetylene welding, etc., will have to be cared for, and it is recommended that it be required that such questions be submitted to the Association with the designs proposed for special cars, for these purposes, for the consideration of the proper committee and the approval of the Association.

Safety Valves.

The standard safety valves have proved entirely reliable for relieving the pressure where tank cars carrying inflammable products have been exposed to accidental fire. The port or ports of the valve which are directed downward toward the tank, should be closed, however, to prevent the injury of the tank by the burning gas thus directed upon it.

A safety valve has been submitted to the committee as an alternative for the standard safety valve. The changes are in the form of the seat, to facilitate grinding and to provide a better escape for water which may lodge on top of the valve, it having been complained that in some cases the ordinary form of valve does not have sufficient depth to accommodate the water and cinders which lodge, and that these cinders cause corrosion. Another change is in the form of the lip, which is more flaring, to give a freer discharge of the gas when the valve opens. The form of the valve and stem has also been changed, the stem being free from the valve, so as to prevent any possibility of cocking the spring cage. Still another change is in the form of the top of the eye on top of the valve, which is flattened and provided with a hole, so that the valve may be rotated on its seat, as well as lifted, using a plain pointed fid.

A test of these valves was made, using an empty tank car with a large steam connection, and both the modified valve and the standard valve. All of the valves were found to work very well—popping freely, the pressure dropping one-half pound before the valve seated. The form of the discharge of the valve was very satisfactory, and your committee is prepared to accept this valve should the designers wish to use it.

The test indicated that the holes in the bottom of the cinder cavity, especially where pointed downward, are objectionable, as during the time the valve is open gas is discharged downward, and in the case of the test at Follansbee it provided a gas flame of a high temperature, which, impigning on the tank, was evidently injurious.

In the proposed alternative valve but one port is provided, and this is turned so as to throw the flame horizontally as far as possible away from the tank.

As regards the setting of the safety valves on existing tanks, the only question is one of expense.

It is claimed that a very large part of the tank car equipment now equipped with safety valves is carrying products having a flash point higher than 80° F., and that with such a product the vapor tension never reaches the eight pounds to which the tank valves are now set.

In the shipment of naphthas, however, especially those of light gravity, there is a probability that the vapor tension, under summer conditions, may exceed eight pounds, and since the wording of the I. C. C. rule provides for the shipment of products having a vapor tension of not over ten pounds, it is evidently desirable that safety valves carrying such products shall not allow the leakage of any product which comes within the terms of the requirements, and, consequently, your committee recommends that all new cars and all existing cars which are in the business of carrying naphthas shall have safety valves set at 12 pounds pressure. Also, that all new valves, and all valves which have to be reset shall be set to a pressure of 12 pounds, which in time will result in all valves, except those on special cars, being set at this pressure, and will allow existing cars to handle casing head naphthas which have been weathered so as to show not more than 10 pounds pressure at 100° F.

Your committee believes, however, that the higher safety valves setting of 20 pounds should be restricted to the special care assigned to the casing head naphtha business, rather than to require existing cars to be changed to accommodate this particular traffic.

Discharge Valves.

Complaints have reached the committee which show the necessity for improvement in the construction of the discharge valves on a great part of the existing tank cars. In some cases the valves are attached to the bottom of a nipple extending downwards from the tank, so that in the event of a serious shifting of the tank in the frame or of any derailment the nipple is exposed to breakage, with consequent escape of the tank contents.

The committee believes that the better plan would be to have the valve entirely within the body of the tank, the outside extension being merely for the purpose of making connection to the discharge piping, and that the valve should be so placed that, in the event of the breakage of the extension, the valve itself would not be unseated.

Plans have been proposed to dispense with the bottom discharge valve, the scheme in brief consisting of a pipe through the upper part of the tank, reaching downward almost to the bottom into a pocket secured to the bottom, the discharge of the tank being effected by means of compressed air, as now common practice with cars carrying acids. Your committee believes that this will be a satisfactory arrangement, and recommends making it optional with car owners.

Welded Tanks.

The construction of the experimental tank used in the tests at Follansbee and Altoona, which was welded without seams, and which after eight fire tests does not show any injurious effects from the fires, and has never shown any indication of leakage, indicates that it is possible by this process to make very desirable tanks from the tightness standpoint. Your committee believes that this is a very desirable form of tank, due to the absolute tightness which results from the absence of seams, and that tanks of this form should be accepted as an option, but the committee is not prepared to require this form of construction. It does recognize the fact, however, that absolute tightness, particularly when hauling inflammables which are normally under pressure, is a very desirable feature.

Your committee feels that the time has come when the safety valves on tank cars should be periodically tested, and the test pressure and date stenciled on the valve, and in order that this may be carried out, it recommends that the absence of the test within the prescribed period and of the stenciling shall be considered an owner's defect.

(Signed) A. W. Gibbs,
C. E. Chambers,
S. K. Dickerson,
E. J. Searles,
J. W. Fogg,
Wm. Schlafge,
Thos. Beaghen, Jr.

Discussion.

At the conclusion of the report, Mr. Gibbs passed around a large number of photographs and also placed on the table a model safety valve. He also suggested that after this specification for wooden underframe tanks be eliminated.

F. W. Brazier: I move that the report be accepted and the committee be given a vote of thanks.

A. W. Gibbs: Cars used for the naphthas would not be suitable for crude oil. Tank cars carrying this, according to the recommendations, should have safety valves set to twelve pounds.

The motion of Mr. Brazier was carried.

SPECIFICATIONS FOR FREIGHT-CAR TRUCK SIDE BOLSTERS.

The committee on specifications for truck sides and truck bolsters was appointed by the Executive Committee in July, 1911, and was instructed to prepare specifications for these structures for freight cars of 80,000, 100,000 and 150,000 pounds capacity. The appointment of this committee grew out of a recommendation made at last year's convention by the committee on revision of standards. The committee has understood its instruction to mean that it was not only to prepare specifications which would cover the physical and chemical properties of the material entering into these structures, but that it should prepare also specifications covering the inspection and physical tests of the complete truck side or bolster. The committee has assumed that it was to deal only with cast-steel structures.

At its first meeting the committee agreed that specifications concerning physical and chemical properties of the material and concerning methods of inspection could properly be based upon the current practice of members of the association, and it accordingly prepared and distributed a circular of inquiry covering these matters. This circular was sent to the members of the association and to all manufacturers of cast-steel truck sides and bolsters. A generous response was made to this circular and the information received has formed the basis for the recommendations touching these matters which are embodied in the report.

Specifications for Cast-Steel Truck Sides.

The following suggested specifications are based upon a study of specifications now in use by members of the association:

Manufacture.

1. Castings furnished under these specifications must be made of open-hearth steel in accordance with the best foundry methods. They must conform to the dimensions shown on drawings and must be free from rust, scale, blow holes, and shrinkage cracks.

2. Each casting must have the following markings cast upon it in raised figures and letters:

a—Initials of the railway company.
b—Month and year in which cast, thus: 6-12.
c—Manufacturer's serial number and trade-mark (or other designation).
d—M. C. B. S.

3. The manufacturer shall have cast on each truck side two test coupons having a cross section of 1⅛ inch by 1⅛ inch and 6 inches long. These coupons are to be used for the physical and chemical tests and their location upon the casting shall be as specified by the purchaser. There shall be two additional coupons of a cross section not less than the average cross section of the casting, which coupons are to be used to determine the character of the annealing as specified in Section 7.

4. The manufacturer shall protect all castings so that they do not become covered with rust. They must not be painted before inspection unless so specified.

5. Truck sides shall not vary more than three per cent above nor two per cent below what has been determined upon as the normal weight of the casting, except that in case the casting has met all requirements save that of overweight, it may be accepted as of the maximum allowable weight here specified. For the purpose of this requirement, the normal weight shall be previously agreed upon between the purchaser and the manufacturer.

6. When the manufacturer is ready to make shipment of the material, he shall notify the purchaser of that fact and await the arrival of the purchaser's inspector, to whom he must furnish free any assistance and labor needed to make satisfactory inspection, tests and prompt shipment.

7. All castings shall be thoroughly annealed. Test coupons shall be annealed with the casting before they are detached. To determine the quality of the annealing the inspector will have one of the test coupons, mentioned in Section 3, cut half-way through and broken off from the casting for examination of the fracture. If, in his opinion, the annealing has not been properly done, he may require the casting to be reannealed, using the second test coupon for examination in this case. If, after annealing or reannealing, any casting is so much out of gauge as to require heating in order to bring it within the gauge, it shall again be annealed before it may be accepted.

Chemical Properties.

8. The chemical composition of the steel shall conform to the following requirements:

Carbon .....from 0.20 per cent to 0.30 per cent
Manganese .....not over 0.70 per cent
Phosphorus .....not over 0.05 per cent
Sulphur .....not over 0.05 per cent

Physical Properties.

9. The physical properties of the steel shall be as follows:
Ultimate tensile strength, pounds per square inch.....
not under 60,000
Yield point (by "drop of the beam").....
not under 50 per cent of the ultimate strength
Elongation in 2 inches, per cent..not less than the quotient of 1,400,000 divided by the ultimate strength

Inspection.

10. For the purpose of determining whether the physical and chemical requirements are complied with, the inspector shall select at random one casting from each heat. From this casting the two physical and chemical test coupons (referred to in Section 3) shall be removed by the inspector. One of them shall be subjected to physical tests, but if the coupon casting proves unsound, the other coupon shall be used in its stead for this purpose. From the coupon which has satisfactorily passed the physical requirements, borings shall be made for chemical analysis. In case the test pieces selected do not meet the specifications, all castings from the entire heat represented shall be rejected.

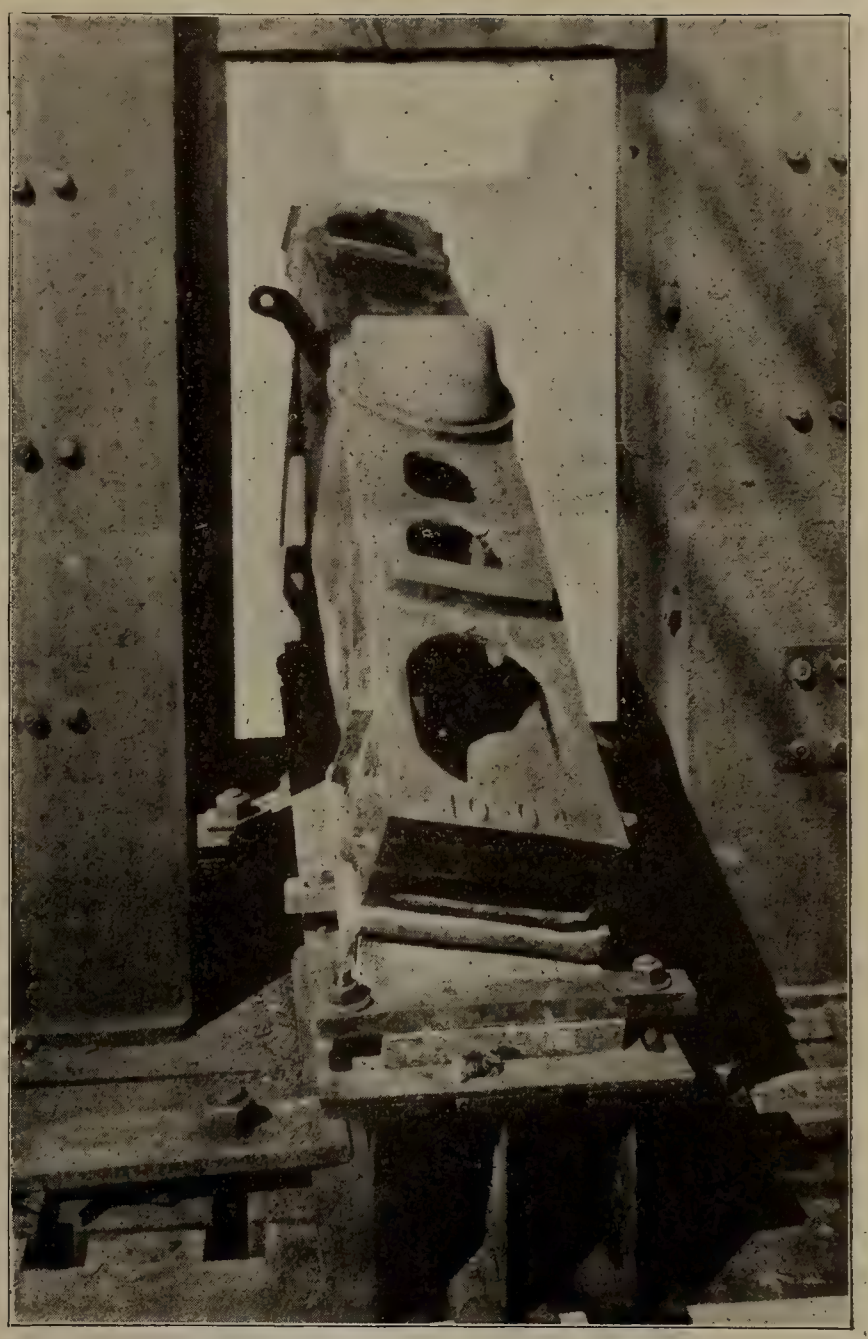
11. At his option, the inspector may require that any or all castings be subjected to sand blast in order to make an examination of the surface for checks or cracks.

12. From each casting rejected by the inspector under these specifications he shall cause to be shipped the "S" of the letters M. C. B. S. which are specified in Section 2.

Tentative Specifications for Static Tests of the Complete Truck Side.

For the reasons previously stated the committee is not ready to make definite recommendations concerning static tests of complete truck sides. It wishes to prevent the following tentative specifications for the purpose of securing for its guidance in future work such criticism as the members of the association may wish to offer.

13. The truck side selected as representing the heat shall be supported in the testing machine at each end, directly beneath the center line which corresponds to the center of the axle when the truck side is in the truck. The load shall be applied in the center of the bolster opening midway between the points of support, and the allowable deflection shall be measured at this point. When so mounted, the truck side shall be subjected to the initial load stated in the following table. The initial load shall be next reduced to 5,000 pounds and then increased to the proof load as stated. Under this proof load there shall be no permanent set and the deflection shall not exceed the amount indicated.



Specifications for Freight Truck Sides, Fig. 1.

For cars of	Initial load, pounds.	Proof load, pounds.	Maximum deflection.
80,000 lbs. capacity	20,000	135,000	⅛ in.
100,000 lbs. capacity	25,000	160,000	⅛ in.
150,000 lbs. capacity	35,000	210,000	⅛ in.

Recommendations Concerning Truck Sides.

Your committee recommends:

1. That the specifications concerning freight truck sides contained in Sections 1 to 12, inclusive, be made standards of the association.

2. That the work of the committee be continued, and that, if possible, funds be provided to make tests upon which specifications for physical tests of the complete truck side may be based.

3. That some committee of the association competent to deal with matters of design, be directed to prepare designs of cast-steel truck sides for freight cars of 80,000, 100,000 and 150,000 pounds capacity, to serve as a guide to those members of the association who now buy these structures made from designs which they do not themselves prepare; in the expectation that such designs may eventually be added to the recommended practice of the association.

Specifications for Cast-Steel Bolsters.

The following suggested specifications are based upon a study of specifications now in use by members of the association:

Manufacture.

1. Castings furnished under these specifications must be made of open-hearth steel in accordance with the best foundry methods. They must conform to the dimensions shown on drawings and must be free from rust, scale, blow holes, and shrinkage cracks.

2. Each casting must have the following markings cast upon it in raised figures and letters:

a—Initials of the railway company.
b—Month and year in which cast, thus: 6-12.
c—Manufacturer's serial number and trade mark (or other designation).
d—M. C. B. S.

3. The manufacturer shall have cast upon each bolster two test coupons having a cross section of 1⅛ inch by 1⅛ inch and 6 inches long. These coupons are to be used for the physical and chemical tests, and their location upon the casting shall be as specified by the purchaser. There shall be two additional coupons of a cross section not less than the average cross section of the

casting, which coupons are to be used to determine the character of the annealing as specified in Section 7.

4. The manufacturer shall protect all castings so that they do not become covered with rust. They must not be painted before inspection unless so specified.

5. Bolsters shall not vary more than three per cent above nor two per cent below what has been determined upon as the normal weight of the casting, except that in case the casting has met all requirements save that of overweight, it may be accepted as of the maximum allowable weight here specified. For the purposes of this requirement, the normal weight shall be previously agreed upon between the purchaser and the manufacturer.

6. When the manufacturer is ready to make shipment of the material, he shall notify the purchaser of that fact and await the arrival of the purchaser's inspector, to whom he must furnish free any assistance and labor needed to make satisfactory inspection, tests, and prompt shipment.

7. All castings shall be thoroughly annealed. Test coupons shall be annealed with the casting before they are detached. To determine the quality of the annealing the inspector will have one of the test coupons, mentioned in Section 3, cut half-way through and broken off from the casting for examination of the fracture. If, in his opinion, the annealing has not been properly done, he may require the castings to be reannealed, using the second test coupon for examination in this case. If, after annealing or reannealing, any casting is so much out of gauge as to require heating in order to bring it within the gauge, it shall again be annealed before it may be accepted.

Chemical Properties.

8. The chemical composition of the steel shall conform to the following requirements:

Carbon	from 0.20 per cent to 0.30 per cent
Manganese	not over 0.70 per cent
Phosphorus	not over 0.05 per cent
Sulphur	not over 0.05 per cent

Physical Properties.

9. The physical properties of the steel shall be as follows:

Ultimate tensile strength, pounds per square inch..... not under 60,000

Yield point (by "drop of the beam")..... not under fifty per cent of the ultimate strength

Elongation in 2 inches, per cent..not less than the quotient of 1,400,000 divided by the ultimate strength

Inspection.

10. For the purpose of determining whether the physical and chemical requirements are complied with, the inspector shall select at random one casting from each heat. From this casting the two physical and chemical test coupons (referred to in Section 3) shall be removed by the inspector. One of them shall be subjected to physical tests, but if the coupon casting proves unsound, the other coupon shall be used in its stead for this purpose. From the coupon which has satisfactorily passed the physical requirements, borings shall be made for chemical analysis In case the test pieces selected do not meet the specifications, all castings from the entire heat represented shall be rejected.

11. At his option, the inspector may require that any or all castings be subjected to sand blast in order to make an examination of the surface for checks or cracks.

12. From each casting rejected by the inspector under these specifications he shall cause to be chipped the letter "S" of the letters M. C. B. S. which are specified in Section 2.

Tentative Specifications for Static Tests of the Complete Truck Bolster.

For the reason previously stated the committee is not ready to make definite recommendations concerning static tests of complete truck bolsters. It wishes to present the following tentative specifications for the purpose of securing for its guidance in future work, such criticism as the members of the association may wish to offer.

The static test proposed below is intended to subject the bolster to stresses which shall be similar in amount and direction to those which it receives in service. To this end the bolster would be inclined in the testing machine both sidewise and endwise, as shown in Fig. 1, and subjected to a vertical load. The angles chosen would be such as to give the following relative magnitudes to the downward, transverse and longitudinal stresses:

Load normal to the center plate surface	100 per cent
Side thrust	25 per cent
End thrust	40 per cent

The above stated relation between stresses is derived from the report of the Committee on Axles, Journal Box, Bearing and Wedge, page 149 of the Proceedings of the Association for 1896. The proposed tentative specification is as follows:

13. The bolster selected as representing the heat shall be supported in the testing machine as indicated in Fig. 1, the bolster being tilted sidewise through an angle of 13 deg. 4 min., and endwise through an angle of 21 deg. 13 min. The load shall be applied vertically through a block with a horizontal upper face, which rests upon the bolster center plate. When so mounted the bolster shall be subjected to the proof load stated in the following table and the load shall then be decreased to 1,000 pounds. Under this proof load there shall be no permanent set and the deflections shall not exceed the amounts indicated. For the purpose of measuring set and deflections the position of the bolster under the load of 1,000 pounds shall be considered as the datum.

For Car of	Proof Load.	Deflection Normal to Center Plate.	Lateral Deflection.
80,000 lbs. capacity	110,000 lbs.	0.15 inch	0.10 inch
100,000 lbs. capacity	140,000 lbs.	0.15 inch	0.10 inch
150,000 lbs. capacity	210,000 lbs.	0.15 inch	0.10 inch

Recommendations Concerning Truck Bolsters.

Your committee recommends:

1. That the specifications concerning freight truck bolsters contained in Sections 1 to 12, inclusive, be made standards of the association.

2. That the work of the committee be continued, and that, if possible, funds be provided to make tests upon which specifications for physical tests of the complete truck bolster may be based.

3. That some committee of the association, competent to deal with matters of design, be directed to prepare designs of cast-steel truck bolsters for freight cars of 80,000, 100,000 and 150,000 pounds capacity, to serve as a guide to those members of the association who now buy these structures made from designs which they do not themselves prepare, in the expectation that such designs may eventually be added to the recommended practice of the association.

(Signed) Edward C. Schmidt,
J. S. Sheafe,
C. D. Young.

Discussion.

I. S. Downing: I think the report is a good one. I move that the committee be continued for another year and that they also consider passenger truck frames.

C. D. Young: I would like to offer an amendment that Paragraphs 1, 2 and 3 be referred to letter ballot.

J. J. Hennessey: I believe it would be better to refer them for recommended practice, and continue the committee.

Mr. Downing's motion as amended was carried.

C. D. Young: I would like to express dissatisfaction with the editorial in the Railway Age Gazette of this morning criticising a paper which had not yet been presented before the association. I move that this matter be referred to the executive committee.

This motion was carried unanimously.

CAPACITY MARKING OF CARS.

The committee appointed to look into and report on the subject of capacity marking of freight cars desires to refer to the report of the committee on axle limits passed upon by the association at the meeting held at Atlantic City in June, 1906 (see pages 299 to 310 of the proceedings for that year).

It would seem this subject of capacity marking of cars was thought to have been definitely disposed of by the association at that time, and the interchange rules were changed to conform to the recommendations of the committee; it will be noted that Interchange Rule 86 makes it optional with the car owner whether he shall stencil his cars with the light weight and nominal capacity, or with the light weight and the maximum weight, depending upon the axle requirements specified in this rule.

However, in order to secure the individual car owner's views in regard to this subject at this time, the committee arranged to have the subjoined circular sent out to all car owners.

"To the Members:

"On pages 97 to 100, inclusive, of the 1911 M. C. B. proceedings will be found a discussion relative to capacity marking of freight cars. The evident intention of that discussion was to revive interest in the marking of the maximum weight on cars as at present time authorized in the second table under rule 86, page 41, of the present M. C. B. code of rules.

"This committee wishes to obtain from the members views relative to stenciling on cars the maximum weight and the light weight, as against stenciling on cars the light weight and nominal capacity. Under the latter method of stenciling cars, a car may be loaded to 10 per cent above its marked capacity. Take, for example, a car marked 'capacity 100,000 pounds'; as a matter of fact, from usage or custom, it is understood that this car has a carrying capacity of 110,000 pounds, although stenciled with nominal capacity of 100,000 pounds. The light weight of such a car, on the basis of carrying capacity of axle, is approximately 51,000 pounds.

"In recent years car-designing engineers have given their best efforts to reducing the dead weight of the car, and instead of a 100,000-pound capacity car weighing approximately 51,000 pounds, some carriers have reduced the dead weight to approximately 41,000 pounds (in some instances less), which fact in reality should increase the carrying capacity of the car about 10,000 pounds, and in fact does increase the carrying capacity of car, were it stenciled its maximum weight.

"The question arises, have the carriers taken advantage of the maximum weight marking authorized by M. C. B. rule 86 so as to increase the carrying capacity and at the same time the earning capacity?

"This committee would appreciate it if you will kindly advise at your earliest convenience whether you are in favor of stenciling freight cars the maximum weight and light weight in cases where you have reduced the light weight of car, permitting, as above illustrated, a greater carrying and earning capacity for the car."

The committee is in receipt of forty-three repiles—a careful analysis of which is as follows:

Replies to M. C. B. Circular No. 25.
Capacity Marking of Freight Cars.

	No. of Replies.	Cars Represented.
(a) In favor of stenciling cars with their light weight and maximum weight.....	19	319,535

(b)	Against stenciling cars with their light weight and maximum weight. (There were no specific reasons indicated in the replies)	8	204,085
(c)	Against stenciling cars with their light weight and maximum weight, for the reason that the maximum weight stenciling is likely to confuse shippers or car inspectors	6	121,350
(d)	Against stenciling cars with their light weight and maximum weight, for the reason that it has not been demonstrated that this practice might not be applied to cars, the body or trucks of which are structurally weak, and which are at present stenciled to carry the maximum load to which they should be subjected	5	209,153
(e)	In favor of stenciling cars with their light weight and nominal capacity, also maximum lading	3	84,079
(f)	In favor of stenciling cars with their light weight and nominal capacity plus 10 per cent. (For instance, an 80,000-pound capacity car would be stenciled 88,000-pound)	1	14,000
(g)	In favor of stenciling cars with their light weight and maximum lading	1	11,000
	Totals	43	963,702

It would appear from this that, notwithstanding the authorization given the car owner as expressed by the vote of the association on this subject at the convention held in June, 1906, a great many companies are timid about adopting the light weight and maximum weight stenciling, for the reason, apparently, that they have no evidence that the construction of cars (including steel and steel underframe equipment) is so consistent as to justify the belief that the car can be loaded up to the full carrying capacity of the axles. It would, therefore, seem desirable for the Master Car Builders' Association to determine for itself the minimum strength of car bodies of each nominal capacity to which the maximum weight stenciling shall apply, and your committee, in order to go into this subject more exhaustively, would recommend that time be granted in which to further consider this subject and make the report.

(Signed) C. E. Fuller.
M. K. Barnum.
A. W. Gibbs.
F. H. Clark.
F. W. Brazier.

Discussion.

C. A. Seley: I move that the suggestions be adopted and the committee continued.

Mr. Seley's motion was carried.

The secretary then read some comments from Mr. Fuller, who was chairman of the committee.

LETTERING CARS.

The chairman, Mr. Crawford, stated that at an executive committee meeting that they had been unable to come to any conclusion.

CLOSING.

This concluded the reports of regular committees, and the report of the committee on correspondence and resolutions was then read by the secretary. This report recommended that a vote of thanks be given to President Stewart, to the Railway Supply Manufacturers' Association and to all others who have contributed toward the success of the convention.

C. A. Seley: I would move that a vote of thanks be extended to the railways which have helped the coupler committee.

This motion was carried.

M. K. Barnum: I move a vote of appreciation to our faithful secretary. The good order with which the business of the association has been carried on is due largely to his work.

J. J. Hennessey: The arbitration committee has probably had more to do with the secretary than anyone, and he has always responded to the calls we have made on him.

Mr. Barnum's motion was carried unanimously.

Secretary Taylor: I appreciate this compliment, and I want to say that it is a pleasure to serve this body.

C. A. Seley suggested that a vote of thanks be extended to all committees that had their reports in by April 1st.

The tellers were not ready to report, and during the wait the following discussion was closed.

C. D. Young: The specifications for our association have no general form, and I would like to see a committee appointed to review all specifications and bring them under a certain form. The American Society for Testing Materials has found such a committee valuable, and I suggest that the executive committee take this matter up.

E. W. Pratt: Limiting strains per square inch on arch bar trucks ought to be included by the committee on truck side frames. I do not think we ought to accept everything in the line of arch bar trucks.

E. A. Miller: We have had considerable trouble during the past winter due to dropping of brake beams, and I think that brake-beam construction should receive more attention. We dropped 50 brake beams on our road last February and March.

J. F. De Voy: I do not think that we can prepare against a winter such as we have had, and I would say that 50 per cent of the failures during this period were due to the extreme cold weather. When the cold weather left us the failures immediately fell off.

F. W. Brazier: I believe that most of our trouble last year was due to the severe weather. I think Mr. Miller's trouble lies in the construction of the cars, as there should be some strap or safety device.

C. A. Schroyer: The hard condition of the track during the past winter has caused much trouble. The arch bar truck will stand a great deal, but after we have reached a certain car capacity we have exceeded the strength of the truck. I think we should stick to the arch bar truck until we have something better.

D. R. McBain: I would suggest that a reduction of speed on passenger and freight trains during the severe weather might be advantageous.

ELECTION OF OFFICERS.

The results from the election of officers for the coming year were as follows: President, C. E. Fuller, Union Pacific; vice presidents, M. K. Barnum, Illinois Central; D. F. Crawford, Pennsylvania, and D. R. MacBain, Lake Shore & Michigan Southern; treasurer, John Lentz, Lehigh Valley. The executive committee to be as follows: R. E. Smith, Atlantic Coast Lines; C. E. Chambers, Central R. R. of New Jersey, and Henry La Rue, Rock Island.

Before the adjournment of the convention, President Stewart was presented with the ex-president's badge.

The Independent Pneumatic Tool Company's exhibit of Thor air tools at the Master Car Builders' and Master Mechanics' Conventions held in Atlantic City June 12th to 19th was well patronized by the mechanical officials of the various railroads represented. Many new tools were exhibited for the first time by the company, principally the Thor roller-bearing piston air drills which attracted considerable attention on account of the possibilities they offer for greater efficiency. It is claimed by the manufacturers that the roller-bearings in the Thor air drills reduce friction to a minimum and actual tests made show the efficiency is increased 30 per cent. Another very important feature in these new drills is the one-piece connecting rod and toggle types. Being of the ball and socket style, this one-piece connecting rod and toggle automatically adjusts itself to any motion, thus relieving it from undue strain. The other tools shown included the Thor close-corner piston air drills which are designed especially for use in close quarters; compound machines of various sizes and capacities for extra heavy work; the Thor electric drill, pneumatic staybolt drivers, turbine air drills for light drilling such as tell-tale holes in staybolts, etc., pneumatic riveting, chipping, calking and flue beading hammers.

The company was represented by Messrs. James B. Brady, W. O. Jacquette, John D. Hurley, R. S. Cooper, J. P. Bourke, T. J. Carroll, H. F. Finney, Geo. A. Gallinger, H. H. Hendricks, John J. Keefe, A. Levedahl, Geo. J. Lynch and R. T. Scott.

Mr. F. T. Heffelfinger, of Minneapolis, has been elected vice-president of the American Arch Co., vice C. B. Moore, resigned to accept the position of vice-president of the Jacobs-Shupert U. S. Fire Box Co.

W. K. Bixby has resigned as a director of the American Car & Foundry Co.

The Brownell Co., Dayton, Ohio, maker of automatic and throttling engines, boilers, feed water heaters, etc., has opened a branch office in the Oliver building, Pittsburgh, Pa., in charge of B. S. Rederer.

Frank M. Gilmore, president of the E. D. E. Co., Chicago, has been made agent for C. H. Whall & Co., Boston, Mass., with office in Chicago.

The Imperial Car Co., Hamilton, Ont., has been organized with $6,000,000 capital to erect a car building plant on a 50-acre site on the water front east of Hamilton. The company will make wooden and steel freight cars. The contract for the construction of the plant and equipment will be let at once. Among the directors are W. G. Rose, director of the Dominion Steel & Iron Co., Montreal, Que.; G. H. Cohan, president of the Western Canada Power Co., Montreal; Sir Henry Pellatt, Toronto, Ont., and Basil Magor, president of the Magor Car Co., Passaic, N. J.

Report of the 45th Annual Convention of the American Railway Master Mechanics' Association

The 45th annual meeting of the American Railway Master Mechanics' Association was called to order by Vice-President Crawford at 9:45 a. m., June 17, 1912. President H. T. Bentley was forced to be absent on account of illness. A prayer was offered by the Rev. Wm. Spurgeon of London, Eng., and as Mayor Bacharach did not appear, the address of President Bentley was then read by Secretary Taylor. Mr. Bentley's address was briefly as follows:

ADDRESS OF PRESIDENT BENTLEY.

It is a pleasant duty and privilege to address you today, and welcome you at this opening of the forty-fifth convention of the American Railway Master Mechanics' Association, and the seventh consecutive one to be held in this beautiful city.

I feel grateful for the honor you have conferred on me, and hope it will be my good fortune at this time, and in the future, to uphold the dignity and prestige of the association, and to follow in the footsteps of my distinguished predecessors in office.

I wish to express my heartfelt thanks to the officers and members of the association who have done so much toward making the convention a memorable one; to the officers and secretary who have so cordially helped me, and to the members who have prepared papers on the various subjects, which I hope will be fully discussed to bring out the best there is in them; to the reverend gentleman who so ably opened the convention with such an uplifting prayer; to the exhibitors who have brought here, for our benefit, one of the most comprehensive collections of tools, supplies, machines and apparatus that has ever been gathered together; to the members of the Supply Mens' Association who have co-operated with us in providing the entertainments and amusements; to the Hotel Men's Association for the splendid manner in which they have taken care of us and made us feel so much at home; and to the members of the press who have helped us individually and collectively; the press we are indebted to for keeping us in touch with what is going on all over the world and without its help we might perhaps be making the same mistakes that other people have made and paid for by dear experience.

At our last convention, I had the pleasure of responding to an address of welcome from your late Mayor, F. P. Stoy, and at that time expressed the hope that he would be with us in the same position as long as we held our conventions here, but as you are probably all aware, Mr. Stoy was taken away from us July 22, 1911, at Wernersville, Pa. The American Railway Master Mechanics' Association owe a debt of gratitude to him for the lively interest he took in our comfort and welfare, and I cannot allow this opportunity to pass without adding a tribute to his memory.

With the tremendous growth of the association during the past few years, considerable criticism has been heard from various quarters as to the increase in cost, extent and amount of entertaining done by the Supply Men's Association, and some people have felt that the formal functions were increasing in formality and the expense was becoming burdensome.

At a joint meeting of the executive committees of the M. C. B., A. R. M. M., and Supply Men's Association, held at New York, October 24, 1911, the question of entertainment was fully discussed, and the committee expressed itself as being under great obligations to the Supply Men's Association for the splendid manner in which they had catered to our pleasure in the past, but it was felt that we could no longer expect them to carry all of the burden and arrangements were made to dispense with the most formal features, such as the reception and ball, substituting informal dances, concerts, etc., where people could thoroughly enjoy themselves; in doing this it was felt that the members and their families would get better acquainted, which is something very much to be desired, and it is sincerely hoped that every one will do their utmost to make things pleasant for one another.

In regard to the cost of entertaining, it was decided that our association would bear its share with the M. C. B. and Supply Men's Association, and thus relieve the latter association of an expense which properly does not belong to it.

The question of consolidating the two associations has been discussed since the last convention, but the feeling of the members generally, appears to be against anything of the sort being done; the thoughts expressed are to the effect that after forty-four years of good service, it hardly seems wise that the American Railway Master Mechanics' Association should lose its identity. It was my thought, however, that the two conventions could be held in one week, Monday and Tuesday being set aside for the Master Mechanics' meeting; Wednesday for a joint meeting of the two associations to discuss matters of common interest, and Thursday and Friday for the Master Car Builders' Association. The principal reason for consolidating is to reduce the time away from business, the present arrangement breaking into two weeks for those attending both conventions, but by handling it as suggested, the depulication of work would be avoided by the joint session, and only five days would be taken up with both meetings.

A suggestion was made on the floor of the General Foremen's Association last year that the members be allowed to investigate and report to the Master Mechanics' Association upon matters pertaining to shop methods and practices, the statement being made that there might be numerous details in shop organization which we were desirous of obtaining information about, but for lack of time had to pass up, and which they were willing and anxious to investigate and report on if asked to do so. This offer was laid before the executive committee, which will probably take advantage of it.

Apart from the experience gained at our meetings through the discussion of the various subjects presented, the opportunity for exchanging ideas among members, when outside of the Convention Hall, is great. I am a warm advocate of meetings of this kind, and know personally that valuable information can be obtained from people who have perhaps gone through some experiences that we are lacking. As expressed at various meetings and places, I believe we should insist on our men attending conventions; it broadens their ideas, gives them new thoughts and puts fresh life into them, so that on their return to business they are better able to grapple with the problems that confront them.

I was fortunately able to attend the annual convention of the International Railway Fuel Association in Chicago last month and listened to some of the best papers on the proper firing of locomotives, proper drafting of locomotives, etc., that I ever heard; the discussions were entered into with enthusiasm, and it was, throughout, a real live convention, our master mechanics and road foremen who attended going away with new ideas for the economical use of fuel in locomotive service. For a four-year-old association it is making wonderful strides, and it is deserving of encouragement.

The question of promoting safety in the operation of railways has received a tremendous impetus lately. About eighteen months ago an organization was started on the Chicago & North Western Railway, in a very humble way, for the purpose of trying to reduce the number of accidents that were occurring daily on our tracks, in the movement of trains and in our shops and roundhouses. The plan worked out so well under the forceful leadership of the general claim agent, and with the assistance of the members of the central safety committee and the local committees on the various divisions, and the results were so gratifying, that the scheme was quickly taken up by all of the large roads in the country, and now, fortunately, nearly everybody has acquired the "safety" habit, or as one road tersely sets forth, "It is better to be careful than crippled."

The past winter has been the most severe in years, as most of us know to our sorrow, and now that summer is here, we must remember our weaknesses and fix our fences before another winter comes along. In the summer we are liable to forget the cold weather, but that is the time to remember it, and taking advantage of the experience gained, to profit by it. It is only by having the engines and roundhouses in first-class condition that the best results can be obtained, and I am sorry to say when the weather is warm we are likely to forget some of the things we promised to do when we were in trouble.

The last year has seen some serious labor difficulties which fortunately are now a thing of the past. The coal strikes in this country were settled without the serious conditions that existed abroad. The engineers of the eastern lines made demands for certain increases, which are being settled by arbitration.

The Federal boiler inspection bill has now been in operation nearly a year, and, generally speaking, we have become accustomed to its provisions and requirements. The extra expense involved is enormous, but, if through its operation the maximum safety is gained, it will be money well spent. There appears, however, to be a number of differences in the rulings made by the inspectors, which is to be expected on account of so many new men being employed, and I believe a committee should be appointed to wait on the chief inspector, to try and bring about greater uniformity, discussing some of the things with a view to a better understanding being arrived at, and also to suggest that we dispense with having to do things that do not improve the safety of the boiler at all. Some of the inspectors' reports sent to our general officers from the chief inspector, cause considerable worry and anxiety, from the fact that they assume, when a report is sent from a government inspector, that their attention is being drawn to some infraction of the law, or a dangerous condition we are all allowing to exist, whereas it may be only a statement referring to some trouble that is not covered by anything in the law itself, or the rules laid down for our guidance. It is perfectly proper to report all cases where the law is violated, but the fact that a flue is leaking on an incoming engine, or some other equally trivial defect exists should not, it seems to me, be sufficient cause for a government report to be made, especially to our general officers.

The question of fuel economy is of greater importance than ever. The railways and locomotive builders, however, have had this before them, and a large number of Mikado engines have been built, which while pulling very little more tonnage than a consolidation engine, have done it with a decrease in coal consumed for the work performed.

In some places the Mallet engines have displaced consolidations with remarkable success in the way of increasing the train load, reducing the number of trains, and doing the work with a reported saving of more than 40 per cent in the amount of fuel burned over other engines engaged in similar service.

The superheater engine has given a good account of itself during the past few months, and the results obtained last winter were, generally speaking, very satisfactory. While we have had troubles on account of lubrication, headers leaking, etc., we are overcoming them successfully for the reason that our education has been improved by our difficulties and where regular men are employed, they soon become familiar with the different conditions brought about by the higher temperatures, so that no more trouble is experienced with superheater than with saturated engines, the

improved results justifying the regular crewing of power, where possible.

Several switch engines have recently been equipped with superheaters and excellent results in the way of fuel and water economy are reported. It would seem that the best results in superheating could be obtained by an engine that is working practically up to its capacity most of the time, and not one in switching service, working intermittently, as most of them do, but the satisfactory service reported as being obtained by superheater switch engines would indicate a field for the device in that kind of work.

While nothing very new has been developed in the stoker line, steady progress has been made with the few that we consider have passed the experimental stage, and a number of Mallet engines have, during the past year, been equipped with them, in one case over 9,000 lbs. of coal per hour having been fed into a locomotive firebox by a mechanical stoker.

The question of efficiency in our shops has not been lost sight of. Careful investigations are constantly being made tending to increase our output and decrease cost, and in this we are being ably assisted by the tool and machine manufacturers, who are very much alive to our requirements.

The headlight question is still a very serious one for us, lack of uniformity in state and railway requirements making it difficult to know what to do for the best. The difference of opinion among railways as to what should be used is perhaps justifiable, for the reason that what would be entirely satisfactory on a busy double or four-track road with block signals, might not be suitable for a single track road with very little traffic and no automatic signals, and it would be far better for the various states to call for a minimum requirement, that would be low, so as to be suitable for a double track road, and then those roads that felt a brighter light was necessary in certain sections, could provide it.

There appears to be considerable progress in the welding up of locomotive broken parts, firebox sheets, etc., by the use of electricity and oxy-acetylene, and a large number of engines that would ordinarily have required new firebox sheets have been kept in service by repairing defects in the old ones. The welding of flues in place is probably going to be a solution of the failures due to flues leaking.

Considerable interest is being taken in the tests of boiler fireboxes of different designs at Coatesville under the direction of our good friend, Dr. Gross; but so far, results of these tests are not forthcoming and we cannot yet say whether the standard design of box will have to give way to one of entirely new shape and form.

Elaborate locomotive tests have been made on the Altoona testing plant in connection with the Chicago committee on smoke abatement to see what effect the different locations of air tubes with steam and air jets in the side of the firebox will have on the amount of smoke emitted; also what benefit is derived from brick arches, air openings in firebox door, etc. When the results of these tests are tabulated, a very useful work will have been accomplished.

The association has a membership of 1,085, which is an increase of only 25 over last year. I believe that all members should try and get this up to 1,300 before another convention takes place.

The National Conservation Congress invited the American Railway Master Mechanics' Association to send a representative to meet with it as a member of an advisory board, and your executive committee instructed me to accept the invitation and take part in the deliberations. The first meeting was held at St. Louis, Saturday, May 11, at which time it was learned that 35 national associations had accepted the invitation to act on this advisory board, which was formed to co-operate with the executive committee and suggest means for furthering conservation in all directions. While the original scope of the congress was to conserve the national resources, such as minerals, water, forests, etc., it was decided at this year's convention that it would be entirely proper to branch out and make a special effort in the direction of conserving vital forces, and this plan of conservation will be brought into prominence at the next meeting.

Questions were aked the attending members as to what their associations were actually doing in the way of conserving our natural resources, and for our association I was able to tell of the improved designs of locomotives that performed a given amount of work with less fuel than other engines of earlier types; the greatest stride in economy that has been made since railways were first put into use was the superheater, which makes a possible saving of nearly one-fourth of the amount of coal used while the engine is working. Also told them what the various railway safety committees were doing in the way of conserving vital forces, and urged the passing and enforcing of trespass laws so that the annual toll of more than 5,000 men, women and children killed while trespassing, could be stopped, or at least materially reduced.

In conclusion, I sincerely hope that our visit here will be beneficial to the companies we work for, and that the few days spent at the seaside will so brace us up that on our return to business we will take a fresh hold of things and accomplish so much more that our short absence from duty will be greatly offset by the new ideas put into effect, greater vim and vigor injected into the business, and, in fact, a general improvement in all directions.

REPORT OF THE SECRETARY AND TREASURER.

The report of Secretary Taylor showed that in June, 1911, the association had an active membership of 1,000, and an associate membership of 19. In June, 1912, the active membership was 1,024, associate membership 21, and honorary membership 40, making a total membership at present of 1,085. The treasurer's report showed that 50 New York City 1¼ per cent bonds had been purchased, and that the cash balance on hand was $1,533.38.

F. F. Gaines moved that the reports be received and referred to an auditing committee. J. W. Fogg, W. E. Dunham and C. H. Rae were appointed members of this committee. The executive committee recommended that the dues for the coming year be fixed at $5.00 as before.

F. C. Thayer, a representative of the Traveling Engineers' Assn., was given the privilege of the floor during the discussions. Applications of the following for honorary membership, having been approved by the executive committee, were granted: H. Tandy, J. S. Turner, W. A. Brown, Thos. Walsh and C. A. Thompson.

ADVISORY TECHNICAL.

G. W. Wildin, chairman of this committee, stated that the matter had been discussed and that they stood in the same position as a year ago, also that the failure of the consolidation of the two associations had handicapped the committee. It would be useless for the committee to represent the mechanical fraternity and the American Railway Master Mechanics' Association, and Mr. Wildin recommended that the matter be dropped and committee discharged.

J. F. De Voy made Mr. Wildin's recommendation in the form of a motion and the motion was carried.

MECHANICAL STOKERS.

Last year the committee expressed the expectation that this year, judging from the progress which was being made in the development of the mechanical stoker, it would be able to report finally on a few stokers which had then been developed sufficiently to render practically uninterrupted service. The committee also pointed out that the principal benefit to be derived from the utilization of a perfected stoker fulfilling the requirements specified was the realization of the maximum boiler capacity of locomotives with the ultimate result of increasing their hauling capacity and reducing their cost of operation per ton mile of service rendered.

The actual service performance of two stokers complying with the specifications laid down in last year's report, as developed by extensive inquiry among railroads who have heeded your committee's request by lending their aid and installing a limited number upon large locomotives justifies your committee in now reporting that these two stokers have, in a measure, fulfilled its expectations, inasmuch as the indications are that their service has been sufficiently reliable in practical operation on a large number of heavy locomotives. These stokers are the Crawford underfeed stoker, which was described in the American Railway Master Mechanics' Association Proceedings for 1910, volume XLIII, and the Street overfeed stoker, described in the American Railway Master Mechanics' Association Proceedings for 1910, volume XLIII.

Both types of stokers in successful service today maintain the same general principles in design originally employed. The improvements made on them, which resulted in making their operation practicable, are improvements of detail only, such as would result from the knowledge gained of the weaknesses of individual details brought out by actual service.

The principal benefit to be secured by the application of the mechanical stoker to large locomotives is the realization of the maximum boiler capacity. When three or four years ago the necessity for passenger locomotives and freight locomotives of still greater capacity than those already in service became apparent, they were not generally considered possible without some device to assist in handling the increased quantity of fuel which it was thought these engines would require. The solution of the apparent difficulty, however, was accomplished to a large extent by providing means which reduced the actual fuel requirements of large locomotives. These means are the superheater, the brick arch, improved boiler, better engine proportions, more scientific methods of firing, and better locomotive maintenance. The fact is being more strikingly realized every day that a five per cent saving in fuel amply warrants the installation of apparatus and the adoption of means which may result in a five per cent increase in the cost of maintaining motive power.

The net effect of these means as far as the stoker is concerned, in spite of the fact that they tend to increase maintenance expenses, has been to defer, to some extent, the absolute necessity of the stoker as a means on present-day engines to get out of them their maximum capacity. It should not be inferred, however, from this statement that the mechanical stoker does not find application to certain engines in operation today, especially of the larger Mallet types which are in continuous service on long mountain grades. On the other hand, too, as the greater sustained tractive efforts of the large engine equipped with superheaters and brick arches is gradually taken advantage of, its fuel consumption per hour will increase, though decreasing on the ton-mile basis, with the eventual result of possibly making necessary to some extent means, in addition to those already provided, to supply fuel to the engine up to its maximum requirements.

When this condition develops, as it is bound to, by traffic increases, careful investigation of tonnage ratings, and the raising to a higher standard the efficiency of operation, the demand for a perfected type of mechanical stoker will become more acute than ever. It is, perhaps, somewhat of a good fortune that the superheater has stepped in and tided over the difficulty that would have resulted while the stoker was in process of development and the demand for large engines becoming more insistent.

Various stokers have been described or referred to in previous reports of your committee. A review of the present status of stokers already called to your attention, as well as a brief description of new stokers under process of development will, therefore, be in order

Crawford Underfeed Stoker.

This stoker, in service on the Pennsylvania and the Baltimore & Ohio, has been developed into a practical operating machine, and is being applied to all of the large Pacific type class K-2 passenger locomotives and the consolidation type, class H-8-C, freight locomotives building for the Pennsylvania Lines West of Pittsburgh. On these lines forty-five locomotives are now equipped and twenty locomotives under construction are being equipped. The Lines East have ten locomotives equipped. The Baltimore & Ohio reports one Crawford stoker in service on a Mallet engine with a grate area of 100 square feet, and a tractive power of 105,000 pounds, working compound.

The forty-five locomotives on the Pennsylvania Lines West, which include some of the earlier designs, have made a total of 7,361 trips up to the middle of March, of which 3,640 were 100 per cent stoker fired, 2,082 between 75 and 100 per cent, and 1,639 below 70 per cent. The per cent stoker fired is in reference to the amount of coal put into the fire box by the stoker; as for instance, a 90 per cent stoker fired trip means that the stoker fired 90 per cent of the coal while 10 per cent was hand fired, the firing by hand being done to fill up spots in the grates which resulted from imperfect distribution of the coal by the stoker. Some capacity tests on the Western Division of the Lines West were run with a dynamometer car on various passenger locomotives, one of which was a Pacific type equipped with a Crawford stoker. The results of these tests have not been completed so as to become available for this report, but the preliminary figures indicated, with respect to the coal consumption, that the stoker made as good a performance as the skilled fireman selected for the hand-fired locomotives.

The Crawford stoker applied to the Mallet engine of the Baltimore & Ohio Railroad has been in service about a year. Some difficulty was experienced with this stoker due to the fact that some departures in design were made from the stoker as originally developed consisting principally in the provision of two cylinders to operate the plungers instead of one. This necessarily added certain complications which subsequently gave trouble. After certain changes, the stoker gave a fair distribution of coal. This stoker is still in service but has not given quite the satisfactory performance so that it could be termed unqualifiedly successful. Inasmuch as this particular stoker is a modification of the Crawford stoker as now perfected for engines of the type to which it has been applied on the Pennsylvania Lines, some difficulty, as experienced with it, might reasonably be expected.

Street Overfeed Stoker.

This stoker is now being built in two somewhat different forms, distinguished from one another as the screw conveyor type and the crusher type. The screw conveyor stoker is built to take screened coal from the tank and distribute it evenly over the grates in the fire box without being handled by the fireman. The coal used by this machine must be passed through a screen having two-inch square mesh before it is placed on the tank. With this type of machine the fireman has no manual labor to perform excepting that of raking the coal on top of the screw conveyor when the supply in the tank is low.

The crusher stoker is designed to take lump, run-of-mine, or slack coal from the tank and distribute it over the grates in the fire box. With this type of machine, all the coal must be scraped or shoveled into the crusher by the fireman. The parts of the stoker on the back boiler head and the distribution systems are the same with both machines. The primary difference between them is in the means provided for conveying the coal from the tender to the distribution system, the screw conveyor type only needing one engine to operate the entire machine, whereas the crusher type needs two; one for the crusher, the other for the conveying mechanism.

Hanna Overfeed Stoker.

This stoker, as far as developed, was briefly reviewed in the Proceedings of the American Railway Master Mechanics' Association for 1911, volume XLIV. It did not fully meet the requirements of your committee.

As a coal-distributing means, the Hanna stoker has successfully demonstrated its possibilities. It has been in continued service on engines of the Consolidation, Pacific and Mallet types, giving a good account of itself, particularly when the engine crews took a personal interest in its operation.

The manufacturers of the Hanna stoker are revising its design and construction so as to increase the scope of their apparatus to comply with the specifications as laid down by your committee.

Barnum Underfeed Stoker.

This stoker as developed so far by the Chicago, Burlington & Quincy Railroad employs screw conveyors located in troughs extending longitudinally just below the grates. The screw conveyors decrease in diameter from the rear of the fire box to the front. Above the conveyors in each trough are a series of inclined plates, adjustable for height and inclination. The clearance between the conveyor and the bottom of the trough may also be adjusted to secure the best results. The conveyors are operated by a transverse worm shaft under the cab deck which is rotated by two small steam engines secured on the outside of the frames. A coal crusher on the latest type of stoker as applied to five 2-10-2 type engines recently built for the Chicago, Burlington & Quincy is also provided. This crusher is driven by a small steam engine located on the tender. It delivers coal to a belt conveyor which transfers it to a transverse trough from which it is discharged into the longitudinal feed troughs.

In addition to the five 2-10-2 type engines equipped above, the Barnum stoker has been in service on a switch engine of the Burlington road operating in Chicago, as well as a Prairie type engine operating in freight service. It is reported as giving good results with both low grade bituminous coal and lignite. It is further reported that the indications at this time for this stoker are that it is a practical machine, assisting in making steam readily and being free from failures and breakdowns.

Dickinson Overfeed Stoker.

This stoker was tried out on the Erie. It employed the fundamental principle of coal distribution of the Hayden stoker further developed. It was equipped with a coal crusher and means for conveying coal, consisting of a screw conveyor transmitting the crushed coal to a bucket conveyor encased in a housing, which bucket conveyor in turn delivered the coal to the distributing mechanism. The apparatus was so arranged that it did not in any way encumber the fire door. The entire machine was driven by two small steam engines; one operating the crusher, the other the conveying apparatus.

The conveying mechanism as well as the distributing device of this stoker were successful, but the coal crusher failed, due principally to its inadequacy. The engines together with a few minor details gave considerable trouble, although the complete combination gave a good showing when in proper repair. For it to be maintained in this condition, however, proved very expensive.

From the experience gained from the above stoker, a second one was designed and built, seeking to avoid all the weaknesses of the first while incorporating all its good points. The modified stoker, as finally placed into operation, used only one engine of a special slow speed design, special form of boot for the elevator carrying all the gearing to avoid encumbering the engine, an improved conveyor, a suitable coal crusher, and better coal distributing means. This stoker was finally placed into operation during the month of February last, applied to a consolidation freight engine. It soon developed that snow and moisture in the coal presented new difficulties by causing the fine coal to dry and cake in the elevator buckets, gradually filling them up, which so diminished the elevating capacity of the conveying mechanism that it clogged and stopped, finally resulting in a failure by breakage of the elevator chain. This trouble was probably due to wrongly designed buckets, since the bucket elevating system as employed in the Street stoker works without trouble. During the operation of the stoker, steam was satisfactorily maintained and the apparatus worked smoothly. It is now proposed to do away entirely with the bucket elevator scheme and substitute in its stead helical screw conveying means.

Conclusion.

Generally speaking, in considering of the foregoing review of the status of the mechanical stoker, your committee feels justified in concluding that decided progress has been made during the last year in the development of the mechanical stoker. While the perfection of the superheater and the brick arch have assisted in making possible a larger engine, it is considered, judging from these indications, that the advent of the perfected mechanical stoker will make possible a still larger engine.

(Signed)

T. Rumney
E. D. Nelson,
C. E. Gossett,
J. A. Carney,
T. O. Sechrist,
S. K. Dickenson,
Geo. Hodgins.

Discussion.

F. F. Gaines: A great deal of work has been done by the committee, and I hope the members who have been using stokers will tell us of their experience.

W. C. A. Henry: We have 75 Crawford stokers in use on the Pennsylvania Lines West, and they have been so satisfactory that 37 more have just been ordered. We are realizing more power with the stoker fired engine. On the South West System we have 10 Pacifics equipped with stokers, the engines being run in pool. During one month 97 per cent of the coal used on these engines was handled by the stoker.

T. R. Cook: We have some figures with regard to these stokers. Out of 11,726 trips over 6,000 were 100 per cent trips. In the last two months the stokers on the Pacific's made 682 one hundred per cent trips out of a total of 992. The consolidation engines made 566 100 per cent trips out of a total of 987. On some of the consolidation engines we have a new design of stoker called No. 17. This stoker has a sloping grate, and carries a lighter and more evenly distributed fire. It has made 36 100 per cent trips out of 41.

J. F. DeVoy. Mr. Henry has said that more power is developed by the stoker firing than with hand firing, and I would like to ask if he has made any tests. We tried out a stoker about a year ago, and found that it did not develop any more power than with hand firing.

W. C. A. Henry: In tests made at Altoona we fired 9,400 pounds of coal per hour by hand firing. On road tests we find that by the use of the stoker we get an economy of from 5 to 7 per cent. We find that our Pacific type locomotives make their schedules easier when equipped with stokers.

C. D. Young: The committee has referred to the B. & O. Mallet compound equipped with Crawford stoker. I think the first attempt was made to apply the stoker to a box greater in width 100 inches, but some very serious problems were encountered. However, a great deal of information was obtained for future design. The Pennsylvania profited by this experience in incorporating a Crawford stoker on one of their Mallet locomotives. This locomotive was tested out between Altoona and Gallitzin, a distance of 13 miles on a 2 per cent grade, and found that the stoker would supply the necessary amount of coal, which was 13,000 pounds per hour. I think that in this case the application

of the underfeed stoker has permitted the maximum capacity of the boiler at low speed. We have also applied the sloping grate stoker to an experimental locomotive, which is the latest development in Pacific design. It has 27x28-in. cylinders, and during the test runs has developed 2,000 boiler H. P. It is equipped with a superheater and a Crawford stoker. The engine has developed 2,500 I. H. P. The engine has not been in service long, and is on the slower trains at present. We are very much satisfied with the results.

Thos. Roope: We have tried the Barnum stoker, and as far as we have gone the results have been very satisfactory. We have tested it with bituminous and lignite coal, and find that it is able to maintain maximum steam pressure at all times. We find it is very effective in abating smoke and it is very popular with the engine men. I have been on the locomotive under adverse conditions, and the results have been very satisfactory.

A. G. Trumbull: We have done considerable work on the Crawford stoker, but have discontinued it this year on account of conditions. We have also paid some attention to the Brewster stoker. With this stoker the vertical conveyor inside the fire box is unsatisfactory on account of the action of gases on the cast iron conveyor. We tried to protect it but had to abandon our efforts, as we found no means of doing so. We hope to be able to do more later on.

F. H. Clark: I think that the stoker is going to help us to get full capacity of the boilers. We have had experience with several; some were satisfactory, some were not. With some the question of distribution is most serious. We have several in service now and they are doing well. We equipped a Mallet having a grate area of 100 square feet with a Street stoker, and seemed to hit it right the first trip made. This engine has been in service about a week, but we have had good reports so far.

C. E. Gossett: I am sorry to report that the Strouse stoker is not working well. We have not had opportunity to know about others.

H. F. Staley: We have a Hanna stoker in service on a Mallet and have been able to maintain maximum steam pressure at all times. However, we have had some trouble when the engine was running light, due to improper handling of the stoker. We are able to maintain maximum steam pressure with a much lower grade of coal than with hand firing. I believe that the stoker isn't an advantage with engines of large type. We do not use a brick arch on this engine.

W. H. Williams: I don't understand why nothing has been said about the Street stoker. We have some large engines equipped with it and it has been working well.

F. H. Clark: We have had a Mikado locomotive running five months with a Street stoker, and it has been satisfactory.

T. Rumney: Mr. Street or Mr. Hayes might be able to say what the capacity is in pounds of coal per hour. It makes a difference if the stoker is used on a low grade line or in a rolling country. Information on this subject would be a guide, and it could be decided in the designing, whether the locomotive needed the stoker or not.

G. H. Baker: We must get men into locomotive service with brains as well as muscle. Locomotives are getting so big that something must be done to relieve manual effort. We must persuade intelligent young men to enter the service, and the stoker is bound to do good in this direction. It will enable the use of big engines where big engines are needed.

C. D. Young: Mr. Rumney's question is a hard one to answer. We have some data as to what has been done by firemen. Last fall some capacity tests were run on the Fort Wayne division over a distance of 105 miles. We had a man who fired an average of 8,400 pounds of coal per hour for three hours at a speed greater than 60 miles per hour, his work being done with a No. 5 shovel. At our locomotive test plant, we have had men fire 9,700 pounds of coal per hour. We could not expect very much more than this, and between 4,000 and 5,000 pounds is the right amount to expect from good experienced firemen.

Angus Sinclair: In talking with a gentleman who had had a great deal of experience, he said that superheated steam would do away with the need of mechanical stokers. This is a short-sighted view of the question. There is a demand for stokers because heavy engines are calling for more coal than a man could supply. We must consider what the maximum demand for steam may be.

W. H. Williams: The item of the grade of coal is important. We are burning a washed slack which is unfit for hand firing.

H. A. Gillis: The question of the human element will always come in. There are times when a man cannot stand the work, but with stokers this does not happen. The up-to-date mechanical department will be equipped with stokers.

D. F. Crawford: With respect to Mr. Rumney's question, we have started with the application of stokers to the heaviest locomotives and have worked backward. We have taken the consolidation locomotives and then gone to passenger locomotives. We do this for two reasons: first. we hope to gain some efficiency, and second, we hope to eliminate smoke, especially on suburban locomotives. With regard to capacity of locomotives, we took some postal cars and loaded then with rails so that they weighed 62 tons each. With 15 cars we made 58 miles per hour and with 9 cars we made 76 miles. In comparing the performances of two locomotives having respectively 39,500 pounds and 42,000 pounds tractive effort, we found that the men used about the same amount of coal, viz: 3,500 pounds per hour. We have thought of applying the stoker to all locomotives requiring over 3,500 pounds of coal.

REVISION OF STANDARDS.

Mr. Demarest, the chairman of this committee, was not present. Mr. Dunham reported that there had been no meeting and the committee had no report.

SPECIFICATION FOR CAST STEEL FRAMES.

This committee had been unable to complete a satisfactory report. Considerable information had been collected, and various ideas suggested, but a difference of opinion on various points existed. The committee, therefore, asked for more time. Angus Sinclair moved that the report be accepted and the committee continued.

MAIN AND SIDE RODS.

One year ago a progress report was submitted, and you were requested to send in criticisms and suggestions.

The committee have received no criticisms or suggestion for changes, and, therefore, must assume that the members are satisfied with the formulae as they stand.

Checking Formulae.

All measurements are given in inches and pounds.

A—Area of section considered.
a—Width of section considered.
b—Depth of section considered.
C_1—Maximum compression unit stress for transverse bending.
C_2—Maximum compression unit stress for vertical bending.
c-c_1-c_2—Coefficients.
d—Cylinder diameter.
L—Length of rod from center to center of pins.
M—Bending moment.
P—Maximum compression strain acting at end of rod.
p—Maximum boiler pressure.
Q—Cylinder pressure equal $0.7854\ d^2\ p$.
R—Radius of driving wheels.
r—Radius of crank.
RG—Radius of gyration of section—axis horizontal.
rg—Radius of gyration of section—axis vertical.
S—Stress,—and where used in formulae must not exceed one-sixth of ultimate strength of the steel.
s—Amount of horizontal offset in rod.
SM—Section modulus of section considered—axis horizontal.
sm—Section modulus of section considered—axis vertical.
W—Weight on pairs of drivers actuated through rod considered.

MAIN ROD AREA MUST NOT BE LESS THAN $P \div 10\,000$ LBS.

FOR MAIN RODS $P = Q$

FOR SIDE RODS $P = \frac{0.3\,WR}{r}$

TO DETERMINE C_1 AND C_2, CALCULATIONS SHOULD BE BASED ON A SECTION HALF WAY BETWEEN ROD PINS

FOR TRANSVERSE BENDING IN RODS HAVING KNUCKLE PINS FLEXIBLE TRANSVERSELY

$$C_1 = \frac{\frac{P}{A}}{1 - \frac{PL^2}{675\,000\,000\ A\ rg^2}}$$

FOR ALL OTHER RODS

$$C_1 = \frac{\frac{P}{A}}{1 - \frac{PL^2}{1\,200\,000\,000\ A\ rg^2}}$$

FOR VERTICAL BENDING IN ALL RODS

$$C_2 = \frac{\frac{P}{A}}{1 - \frac{PL^2}{300\,000\,000\ A\ RG^2}}$$

VALUES FOR C_1 AND C_2 CAN ALSO BE TAKEN FROM TABLES IN "KENT'S POCKET BOOK" UNDER HEADING "MERRIMAN'S RATIONAL FORMULA FOR COLUMNS".

FIRST—
FOR RODS WITHOUT OFFSET THE LARGER VALUE OF C_1 AND C_2 SHOULD BE TAKEN EQUAL TO S.
FOR RODS WITH OFFSET THE LARGER VALUE OF $C_1 + \frac{P_s}{sm}$ AND C_2 SHOULD BE TAKEN EQUAL TO S.

SECOND—

$$S = c\,\frac{AL^2r}{SM} + c_1 P\left(\frac{1}{A} + \frac{s}{sm}\right)$$

THE CALCULATIONS SHOULD BE BASED ON A SECTION LOCATED AT A DISTANCE 0.6 L FROM CROSSHEAD PIN FOR MAIN RODS, AND HALF WAY BETWEEN PINS FOR SIDE RODS.

VALUES OF c AND c_1

REV. PER MIN.		265	325	375	420
MAIN ROD	c =	0.036	0.055	0.073	0.091
	c_1 =	0.500	0.500	0.400	0.300
SIDE ROD	c =	0.071	0.106	0.142	0.177
	c_1 =	0.500	0.500	0.500	0.500

THE COEFFICIENTS SELECTED SHOULD CORRESPOND WITH THE HIGHEST NUMBER OF REVOLUTIONS PER MINUTE WHICH THE LOCOMOTIVE CAN MAKE.

IF THIS CAN NOT BE DETERMINED, USE
420 RPM FOR HIGH SPEED PASSENGER LOCOMOTIVES
375 " " PASSENGER AND HIGH SPEED FREIGHT LOCOMOTIVES
325 " " ALL OTHER LOCOMOTIVES

The coefficients selected should correspond with the highest number of revolutions per minute which the locomotive can make.

If this can not be determined, use 420 r. p. m. for high speed passenger locomotives; 375 r. p. m. for passenger and high speed freight locomotives; 325 r. p. m. for all other locomotives.

Very simple rules for rods, without offset, and having bodies with rectangular section, based on the above theory, follow.

FIRST—STRESS IS LESS THAN ONE SIXTH OF ULTIMATE STRENGTH OF THE STEEL IF "L" IS LESS THAN 46 "a" OR 23 "b" AND IF "A" IS MORE THAN "P" DIVIDED BY ONE EIGHTH OF ULTIMATE STRENGTH OF THE STEEL.

SECOND—

$$S = c_2 \frac{L^2 r}{b} + c_1 \frac{P}{A}$$

VALUES OF c_2 AND c_1

REV. PER MIN.		265	325	375	420
MAIN ROD	c_2 =	0.22	0.33	0.44	0.55
	c_1 =	0.50	0.50	0.40	0.30
SIDE ROD	c_2 =	0.43	0.64	0.85	1.06
	c_1 =	0.50	0.50	0.50	0.50

THE ALLOWABLE STRESSES FOR THE VARIOUS SECTIONS OF ROD ENDS ARE GIVEN IN CONNECTION WITH THE DIAGRAMS FOLLOWING, EXCEPT WHERE THICKNESS OF SECTION IS INDICATED BY THE LETTER "b." THE FIGURES DENOTE MAXIMUM STRESS ALLOWED UNDER END LOAD "P." IF THE MINIMUM AREAS OF THE TWO MEMBERS DIFFER, TAKE DOUBLE THE LESSER AREA FOR "A."

THE MINIMUM AREA AT POINTS INDICATED BY LETTER "b" SHOULD BE—

FOR MAIN RODS— $A = \frac{PX}{30\,000\ b}$

FOR SIDE RODS— $A = \frac{PX}{60\,000\ b}$

IN WHICH "X" IS THE AVERAGE DIAMETER OF EYE OR AVERAGE SPREAD OF JAW MEMBERS

We, therefore, submit to you the above checking formulae as recommended practice.

W. F. Kiesel, Jr.
H. Bartlett,
G. Lanza,
H. B. Hunt,
W. E. Dunham.

Discussion.

O. C. Cromwell: We have found some advantage in increasing the fillets joining the central section to the stub.

W. F. Kiesel: It is conceded that the transition from body to stubb must be made gradual.

C. A. Seley: Some rods give a very satisfactory performance and some do not. I move that the paper lay over one year for consideration when the question of adopting it as standard will be considered.

This motion was carried.

SAFETY VALVES.

1. The suggestions given below apply to oil and coal burning locomotives, whether using superheated or saturated steam. Safety valves suitable for the requirements of coal-burning locomotives should be ample for those burning oil, inasmuch as the enginemen have control of the fire of an oil-burning locomotive to a greater extent than on coal burners.

Formula for Determining the Size of Valves Required.

2. In view of the variation in the various makes of safety valves as regards lift, we feel any formula used should take this item into consideration. We do not believe that any change should be made in the formula proposed by the committee of the American Railway Master Mechanics' Association in 1910, except that the lift and diameter of the valve will be substituted for the area. We, therefore, suggest the following formula:

Assuming Valves Have 45-Degree Seat.

D—The total of the actual diameters of the inner edge of the seats of valves required.

H—Total heating surface of boiler in sq. ft. (Superheating surface not to be included.)

L—Vertical lift of valve in inches.

P—Absolute boiler pressure in lbs. per sq. in.

$$D = .036 \times \frac{H}{L \times P}$$

Example.

$$\frac{.036 \times 2878}{.1 \times 200} = 5.2''$$ diameter.

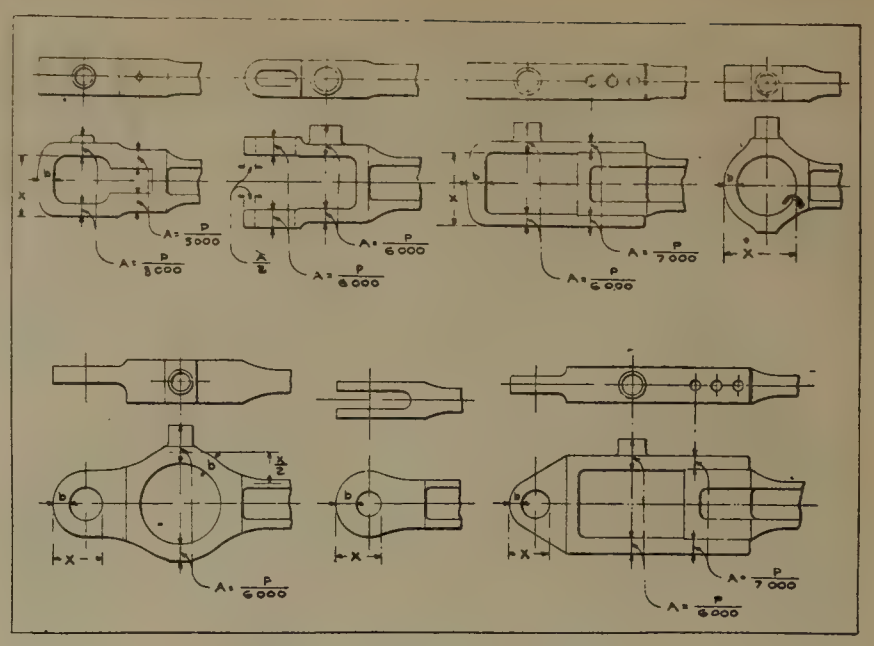
which would require two 3-inch valves.

Determining Maximum Capacity of Safety Valves.

3. The only accurate method of determining the capacity of safety valves is by actual test in a testing plant, with safety valves fully equipped with springs, as in actual road service. In order that it should be positively known that safety valves will prevent undue raise in pressure under extreme conditions, they should be subjected to a road test.

Number and Size To Be Applied.

4. Every locomotive should be equipped with not less than two, and not more than three safety valves, the size to be determined as per formula in paragraph 2. Safety valves to be set as follows:



Sections Used for Checking.

First—Boiler pressure.
Second—Two lbs. in excess.
Third—Three lbs. above second, or five lbs. in excess of first.

Metal Recommended for Valves and Valve Seats.

5. No metal has yet been developed as entirely proof against erosion. Nickel seats and valves are undesirable on account of first cost and cost of renewals; therefore, your committee's recommendation is to continue the use of bronze alloys.

Stamping Lift on Valves.

6. Manufacturers should be required to stamp on the valve the lift in inches, as determined by actual test, with valve in working condition, and set for a blow-back of not to exceed 3 lbs. Your committee recognizes the fundamental importance of valve lift. It, therefore, recommends that in design and manufacture valve lift receive proper consideration.

Estimating Steam Discharge.

7. Steam discharge from safety valves of given size can be estimated closely by the use of Napier's rule for flow of steam, as follows:

Flow of steam per second:
Absolute pressure in lbs. per sq. in., multiplied by area in sq. in. of discharge opening, divided by 70.
Multiplied by 3,600 gives flow in lbs. per hour.

Location of Valves on Boiler.

8. The location of safety valves has much to do with the normal crest of the water in the boiler; therefore, safety valves should be located at the highest point on the boiler, where clearance limits will permit, in vertical position, avoiding the use of piping, long nipples and ells between safety valves and boiler.

Spacing in Dome.

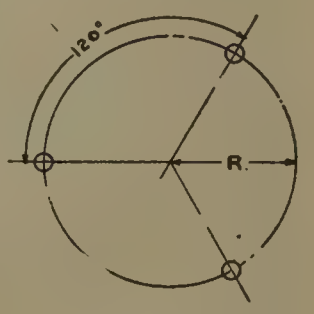
9. Where safety valves are located on an independent dome, they should be spaced as per Plate No. 1. The opening from boiler into dome and the area between supporting ribs in dome should not be less than inlet area of valves. If this is not done, the opening will momentarily reduce pressure, causing valve to flutter and hammer.

Hydrostatic and Other Tests.

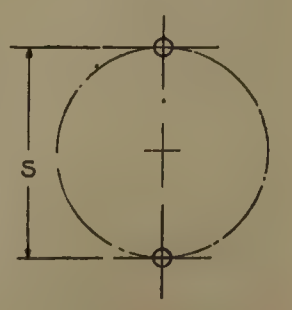
10. The practice of screwing down the safety valve spring during a hydrostatic test of boiler should be discontinued. Valves with springs designed for certain pressures should not be subjected to extreme pressures. One safety valve should be removed and re-

VALVE SIZE	SPACING S	RADIUS R
$4\frac{1}{2}$"	9"	$5\frac{3}{16}$"
4 "	$8\frac{1}{2}$"	$4\frac{7}{8}$"
$3\frac{1}{2}$"	8 "	$4\frac{5}{8}$
3"	$7\frac{1}{4}$"	$4\frac{3}{16}$
$2\frac{1}{2}$"	$6\frac{1}{2}$"	$3\frac{3}{4}$"

APPLICATIONS MADE AS DESCRIBED PERMIT USE OF WRENCH FITS RECOMENDED & MOVEMENT OF STANDARD WRENCH ONE SIXTH OF A TURN WITH A REASONABLE MARGIN



THREE VALVES



TWO VALVES.

Location of Safety Valves.

placed with a special high-pressure valve, and the other valves should be removed and replaced with caps or plugs during test.

Standard Connections.

11. In order to make valves of different manufacture interchangeable, recommend standard thread and diameter of valves at connections as follows:

2½-in. safety valve	2½-in. U. S. S. pipe thread	8 threads to in.
3 -in. safety valve	3 -in. U. S. S. pipe thread	8 threads to in.
3½-in. safety valve	3½-in. U. S. S. pipe thread	8 threads to in.
4 -in. safety valve	4 -in. U. S. S. pipe thread	8 threads to in.
4½-in. safety valve	4½-in. U. S. S. pipe thread	8 threads to in.

Valves of above sizes to be made for U. S. S. wrench fit.

Inspection of Old Springs.

12. As it has been found that the condition of the safety valve springs greatly affects the discharge capacity of the valve, old springs should be tested as to their deflection under load before being used in repaired valves.

Repairs to Safety Valves.

13. Safety valves should be thoroughly overhauled and put in good condition whenever the locomotive is in shop for general repairs. Standard gauges should be used in order that important dimensions may be maintained as originally designed. If this is not done, it generally impairs the efficiency of the valves.

We desire to thank the various manufacturers and members for the assistance rendered us.

(Signed) W. J. Tollerton.
I. B. Thomas.
W. D. Robb.
E. C. Schmidt.

Discussion.

M. Flanagan: I note that the report recommends pipe thread connection. I think we can get better results with a straight thread and screwing the valve down to the shoulder.

W. J. Tollerton: No two manufacturers are turning out a standard connection. In this standard connection we used a U. S. standard pipe tap. We also found it difficult to get a standard wrench fit. The pipe tap has the disadvantage that it is liable to stretch the valve.

C. D. Young: In paragraph 4 it is recommended that not more than three safety valves be used. We have not found a case where three safety valves were needed. If three valves are desired, would suggest that the setting of the second valve be changed from 2 to 3 pounds I would like to ask the committee for more information with regard to nickel seats and valves. In paragraph 11, I would suggest inserting after "recommended," "where valves are threaded."

W. J. Tollerton: With regard to nickel seats, very few are being used, and we don't recommend them. The insertion of a nickel seat in the brass body of the valve is very difficult. With respect to the number of valves, we find a great many are using three valves. The variation between the first and third valves is so great that the third valve is not working most of the time.

J. F. DeVoy: In ordinary practice one pop valve will take care of any steam generated. However, the third valve will take care of any contingency. The St. Paul has always favored the third valve for this reason. Two additional valves in the case of a boiler explosion will always give a man a minute or two longer to preserve his life, and I think the report of the committee is about right. It is well to risk the extra $20 and know that you have done everything to protect the man operating the boiler.

W. J. Tollerton: None of the large users of oil burners have changed the number of pop valves.

J. F. DeVoy: With reference to section 13, I want to know if the rule will conflict with what boiler inspectors want us to do.

W. J. Tollerton: No, it is not intended to conflict.

J. F. DeVoy: I move that the report be accepted and referred to letter ballot.

T. R. Cook: With regard to stamping the lift on the valve, it is not my understanding that the lift determines the capacity. There is considerable difference in the discharge of valves having the same lift.

W. J. Tollerton: The figures have nothing to do with the discharge of the valve. They indicate the lift so one can figure up the capacity.

O. C. Cromwell: With regard to paragraph 11, we should have standard thread gauges for that fit if we should maintain the standard. It is necessary to keep threads up to close dimensions, and I think that this suggestion should be incorporated. I note that it says that valves are to be made for U. S. Standard wrench fit. I don't know how much larger this is than our present fit, but if this is enlarged we will have trouble.

W. J. Tollerton: The committee took up this matter with the manufacturers and they agreed to a standard wrench fit. The wrench fit will clear on any valve it will go in. Very little is added to bring wrenches up to U. S. standard size. The increase is not over $\frac{1}{16}$ to $\frac{2}{16}$ inch on each side.

C. D. Young: I want to refer to Mr Cook's point regarding the lift. Mr. Nelson did much work on testing the lift of pop valve, but found it impossible to obtain any accurate determinations. I think it would be well to change to some figure indicating the capacity of the valve. I wish to make an amendment to Mr. DeVoy's motion that the report go back to the committee for further consideration.

C. A. Seley: This report has been before the convention two years and the formula for this charge is about the same as it was a year ago. I believe the lift can indicate capacity of the valve, and I would say that the recommendations of the committee should be carried out.

J. F. DeVoy: I know of no way to measure discharge to a valve unless you know the lift.

W. J. Tollerton: As regards the lift, I think it of the utmost importance that this be stamped on the valve, and I can see no objections to stamping it on.

C. D. Young: If the committee will accept the suggestion with regard to stamping the discharge of the valve also, and my suggestion with respect to nickel seats, I will withdraw my amendment.

W. J. Tollerton: I do not think that paragraph 5 should be taken out as it shows that we have looked into the question of nickel seats. However, we couldn't find where nickel seats were in use on any number of railways.

C. D. Young: Paragraph 5 says that nickel seats are desirable, but that they are too expensive; that is, they are not recommended because they are expensive.

T. Rumney: We might change this paragraph to read, "nickel seats and valves although providing an improved lift are undesirable because of first cost and cost of repairs; therefore, the committee recommends the continuation of the use of bronze alloys."

Mr. Tollerton accepted this change, and Mr. DeVoy's motion with the amendment was passed.

TUESDAY, JUNE 18.

CONSOLIDATION.

D. F. Crawford: (Chairman) The committee wishes to report that general feeling is not in favor of consolidation, and as the M. C. B. Association has continued its committee, I move that the committee of this association be continued until the next meeting of the executive committee.

This motion was carried.

F. F. Gaines: I would like to know if the committee will consider President Bentley's suggestion with respect to the meeting time.

D. F. Crawford: I would say that this will be considered at the executive committee meeting.

SAFETY APPLIANCES.

All members of this committee were absent, and it was postponed until next day.

DESIGN, CONSTRUCTION AND INSPECTION OF LOCOMOTIVE BOILERS.

The committee sent out a circular of inquiry to all members of the association in regard to their experience and recommendations concerning construction of locomotive boilers. We received replies from twenty-one members, comprising a total of 22,900 locomotives, which is about one-third of the locomotives represented. The intention of this committee is to give the different members the benefit of the experience of the different railroads.

Type of Boiler.

In no case is a special type of boiler used for any special service. One of the members advises that his road uses Belpaire boilers of crown bar construction for road engines entirely on account of greater ease in maintaining staybolts. Another member advises that they use the Belpaire boiler as well as the radial stay boiler, and their experience with the Belpaire boiler is that it reduces the number of staybolt breakages, which has been proven by the records of staybolt breakages. From the experience that they gained with Belpaire boilers they developed a system of cross bracing, shown by Plate A, which has practically all the advantages of the Belpaire staying, and in addition it reduces the dead weight and is cheaper to construct.

Crown-bar construction is not used to any extent on wide firebox boilers, but a few roads use the crown-bar construction on narrow-type fireboxes. On the crown-bar type of boiler it is found to be a hard matter to keep the crown bars free from mud, but in renewing fireboxes on this class of engines beneficial results have been obtained by raising the crown bars and inserting higher washers—1½ to 2 inches.

The committee was unable to get any data in regard to merits of Belpaire boiler compared with the radial stay boiler, as far as maintenance and boiler performance is concerned.

From the replies received from the different members it is the

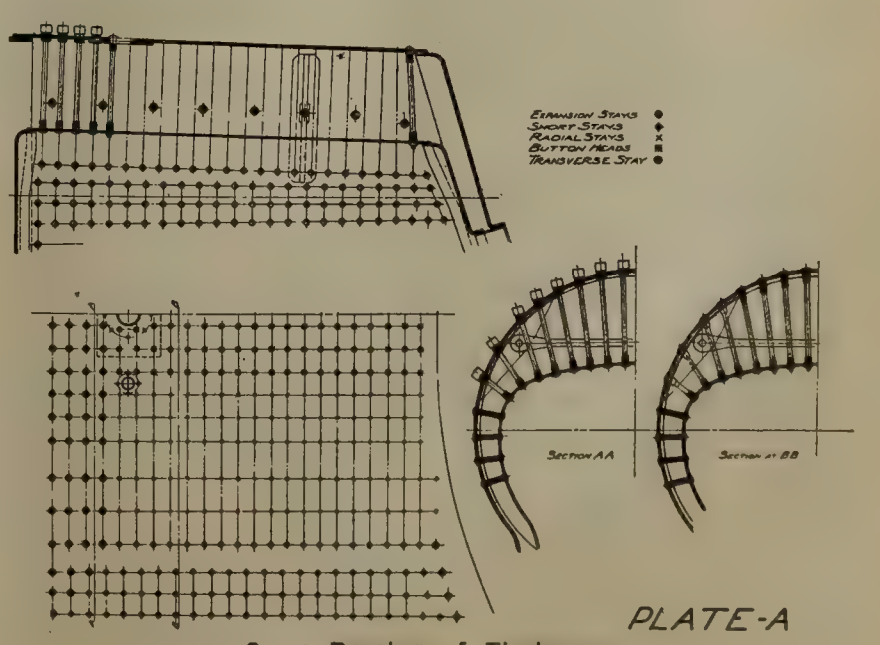
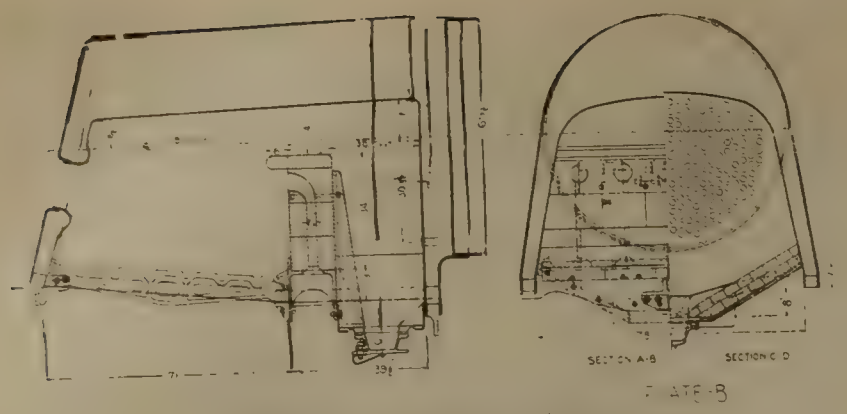


PLATE-A

Cross Bracing of Fireboxes.



Successful Combustion Chamber.

consensus of opinion that the radial stay type of boiler is preferred, as it is easy to construct, giving more free circulation of water, less deposit of sediment on the crown sheet and easier to wash out; also the dead weight is kept down considerably.

Combustion Chambers.

From the replies received the combustion chamber is only favored by five members. One member, who uses the combustion chamber covered by Plate B, advises that it shows a great economy in fuel, a decrease in the amount of smoke and cinders and increased mileage. No information was given in regard to maintenance. Another member advises that the reason they favor the combustion chamber in certain types of boilers, such as Mallet, is that it keeps the tubes a reasonable length and increases the heating surface of firebox. No information was given as to the fuel economy derived from these combustion chambers, but a saving in maintenance and an improvement in performance is reported.

Another member reports being in favor of combustion chambers, but does not have them on all engines. This member was from an anthracite road and the particular claim was they thought they got better combustion and also derived a good deal of benefit in the way of protection of flues, particularly so, the boxes being extremely shallow below the flue sheet. Type of combustion chamber used by this member is shown on Plate D-1.

Another member advises that they have had five passenger engines with combustion chambers, but considerable difficulty was experienced keeping the seams tight, and on account of this fact combustion chambers were removed when applying new fireboxes. This was the first development of the combustion chamber which has been materially improved since that time.

Another member advises that they have had all combustion chambers removed on account of costing too much to maintain.

The advantages claimed by the use of combustion chamber are that it keeps the tubes within a reasonable length, protects the flue beads, increases the firebox heating surface and gives better combustion.

Your committee feels that a combustion chamber is desirable on boilers with extra long flues, such as Mallet and Mikados, but are not prepared to recommend any particular design.

Firebox.

Continuous crown and side sheets are favored by all of the members except one. Therefore, the committee recommends the use of continuous crown and side sheet for new construction or with renewal of firebox.

Mud-Ring Corners.

Your committee recommends mud rings with large radius, as shown on any one of the plates and the flanges of the tube and door sheet should be carried back far enough to get at least three straight rivets through the ring. Scarf the inside sheets down to be properly fitted to the mud ring by heating the same. If the scarfing and the fitting of these sheets is given proper attention it will overcome leaky mud-ring corners that some of the members are now experiencing considerable difficulty with.

Throat Sheet.

From the replies received, the distance from the top of the grate to the bottom of the lowest boiler tube on wide firebox engines is a minimum of 14 inches and a maximum of 26 inches, average about 22 inches. Narrow fireboxes have a minimum of 13 inches and a maximum of 28½ inches, average about 20 inches.

One member who uses hard coal advises a distance of 8⅛ inches minimum and 12 inches maximum. This height is limited due to the design of the locomotive.

Your committee recommends as deep a throat sheet as the design of the locomotive will permit. On consolidation engines the depth of the throat sheet is limited, due to the frame passing under firebox and on account of rear driving wheel, which is located under firebox.

On Atlantics, Mikados, Mallets and Pacific type engines a deeper throat sheet can be obtained, as it is not necessary for the frames to pass under the firebox.

From the replies received in regard to thinning out of flue and door sheets, also the use of countersunk rivets where these sheets are joined to the side sheets, it was found that about fifty per cent of the members thin out these sheets and apply countersunk rivets. It is generally acknowledged that the thinning of the sheets and the countersinking of rivets is necessary on oil-burning locomotives. The general practice seems to be to countersink these rivets about half way up the side sheet. No data were given in regard to which practice is the best from a maintenance standpoint.

Spacing of Rivets in Firebox Seams.

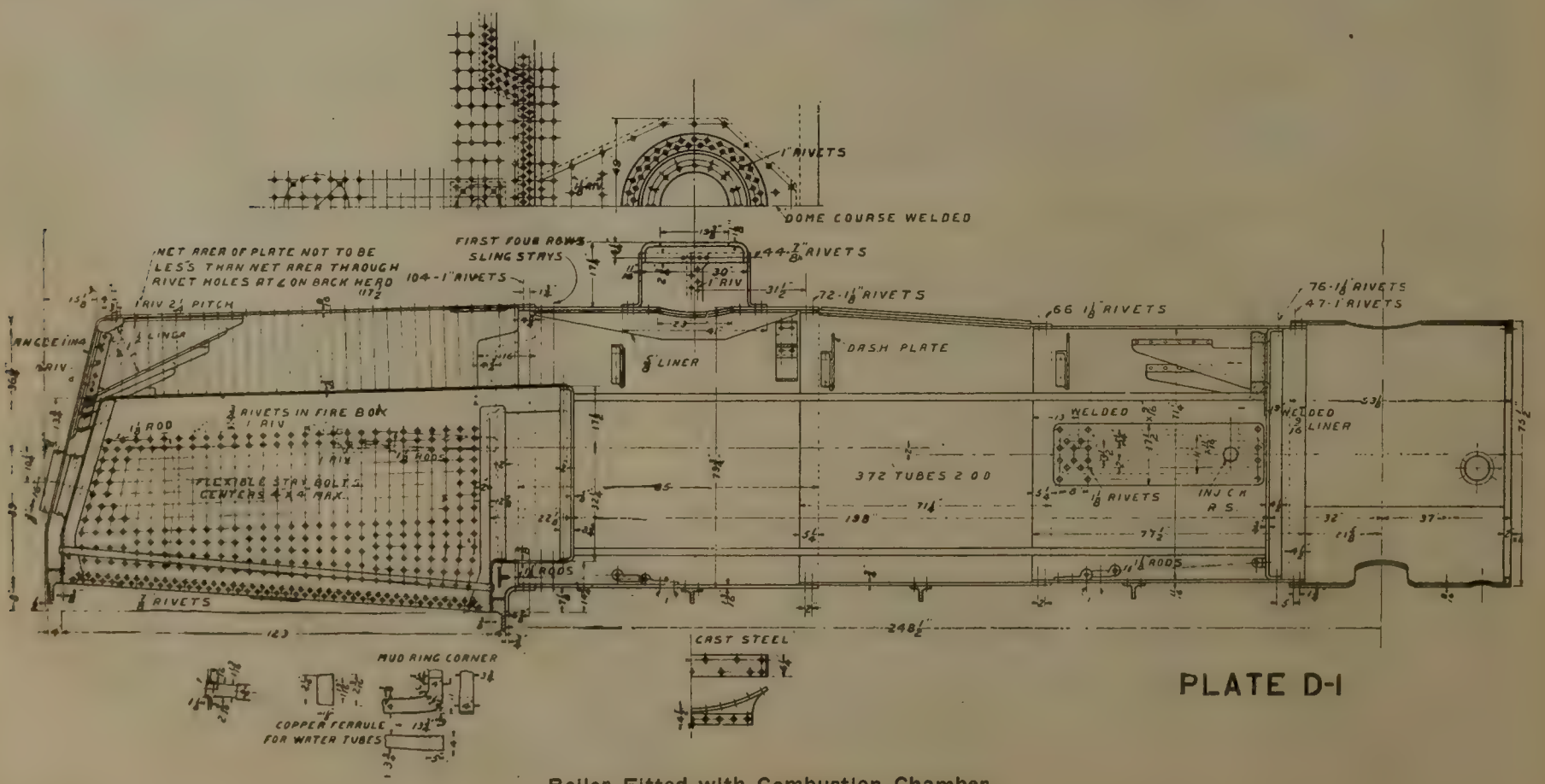
Your committee suggests ¾-inch rivets spaced two inches apart, as this is used by the majority of the members who replied to the circular.

Design of Fire-Door Hole.

Plate O shows various designs of fire-door holes used by different members. Three members advise that they use style No. 2, which is the O'Connor type of fire-door. One of the members reports that they have 1,200 locomotives equipped with the O'Connor type of fire-door for a number of years. On boilers equipped with this type of fire-door flange they have had several cases where the door sheets have remained in perfect condition although two sets of side sheets and a second back-flue sheet had been applied and cracked badly. In every instance the door hole remained in practically perfect condition when the rest of the firebox was cracked to the point of renewal. Boilers equipped with this type of fire-door hole give larger water space, few stay bolts about the door seam, seem to give freedom for expansion and contraction and also largely prevent mud and scale collecting at this point.

Six members favor style No. 5 and eight members style No. 4.

It seems to the committee that style No. 1 would have a tendency to collect mud and burn out. The committee has no choice between styles Nos. 2, 3, 4 and 5.



Boiler Fitted with Combustion Chamber.

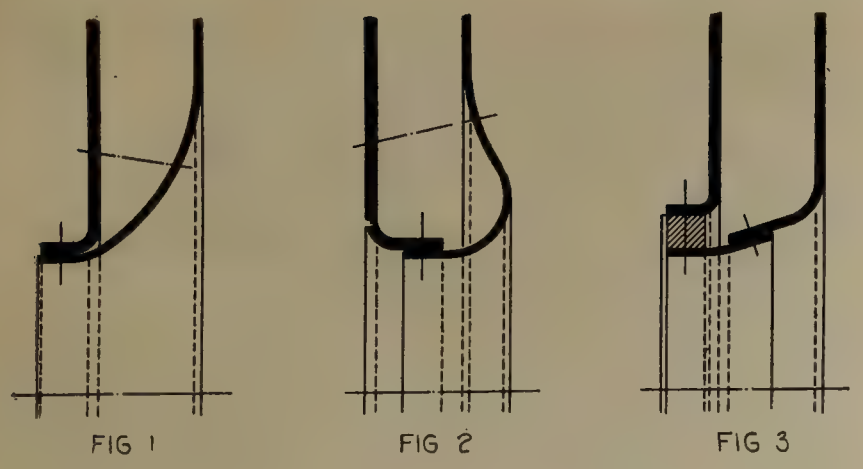


FIG 1 FIG 2 FIG 3

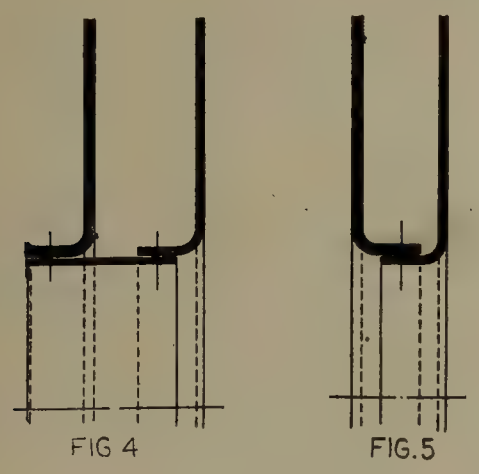


FIG 4 FIG.5

PLATE-O

Fire Door Holes.

Number and Size of Fire Doors.

We find that various sizes and numbers of door holes are used on different types of boilers.

Arch Tubes.

Of the replies received, fifteen members use 3-inch tubes, one member uses 2-inch tubes and one member uses 2¼-inch tubes. Five members do not use arch tubes at all. One member supports brick arches with studs fastened into the side sheet.

Thickness of tubes used: .15-inch, .165-inch, .18-inch; .203-inch, .25-inch. Eight members use thickness of .18-inch. Eleven members use seamless steel, one member uses charcoal iron, thickness of tube not given.

Plugs or Plates Covering Arch Tube Holes.

Twelve members use brass plugs; one member uses extra large size brass plugs for covering the holes; these plugs are drilled for 2¼-inch plug so as to avoid removing the large brass plugs when washing the tubes. Three members use plates with ball joints, claiming greater ease in removing and applying in close quarters.

Method of Setting Arch Tubes.

The setting of arch tubes varies. The replies received were indefinite as to just what practice they are following out.

Six members did not state whether they use copper ferrules or not. Six members advise that they use copper ferrules in setting arch tubes. Three members set the arch tubes without ferrules. Three members set the tubes with a roller expander and a sectional expander to be used in the ordinary manner to set out the tube. Tubes are then beaded over with a bootleg tool, except by one member who bells out the tube on the water side to prevent the tube from pulling out of the sheet. This member does not use any ferrules. The other two members do use copper ferrules.

The committee has been unable to get any information in regard to which type of flue setting gives the best service, therefore are unable to make a recommendation as to which type we would recommend as standard practice.

Radius of Flange in Back Tube Sheet.

Replies received in regard to the radius in the back tube sheet where it connects to the crown sheets. Recommendations were made from ½ inch up to 2 inches. Some members had trouble with cracked sheets and leaky seams with large radius; others had trouble with the small radius. One member advises that he is now experimenting with a 4-inch radius and it seems to give good satisfaction, but it has not been in use a sufficient length of time to give a complete report. Two members increased the radius from ⅞ inch to 2 inches and had considerable trouble with flue sheet working up and the flanges cracking. Two-inch radius has been discarded and they are now using ⅞ inch, which improves the condition but does not eliminate the difficulty entirely.

Distance Inside of Flange of Back Flue Sheet to Edge of Flue Holes.

Your committee recommends that a distance from the inside of the back flue sheet to the edge of the nearest flue hole to be ample to prevent the flue sheet cracking through the flange. This distance will vary, depending on the radius of the flange of the tube sheet. Tube sheets with ⅞-inch radius, this distance should be at least 2 inches at the top, ⅞ inch on the side. Sheets with 2-inch radius, the distance should be at least 2½ inches at the top.

Method of Supporting Grate Side Frames.

Your committee recommends the grate side frames to be supported from studs in the mud ring or brackets fastened to the inner side of the mud ring, the latter forming a pocket for the grate side frame to fit into.

Sloping Back Heads.

Sloping back heads are used by practically all of the members who replied to the circular. The slope varies from eight degrees to twenty degrees, making an average slope of twelve degrees. Sloping of back heads gives additional room in the cab, reduces the weight of the boiler and gives a maximum length of firebox, and still remains within a reasonable limit for hand firing.

Staybolts.

Uniform spacing of all staybolts in all parts of the firebox is recommended by your committee. The majority of the members reported the use of button-head crown stays for the six to nine center rows of the crown sheet the entire length; two members use hammered heads for the first four or five rows from the flue sheet.

Your committee favors the use of button-heads on as many rows as the design of firebox will permit, but recommends for the consideration of members the practice of using hammered heads on the first four or five rows back from flue sheet.

Sling Stays.

Plates V and V-1 show the various types of sling stays in use by the different members and no difficulty with any of these types has been reported. Three members use a special flexible staybolt on all new equipment, as shown by Plate W, and the use of this type of sling stay is also favored by, but not used by, another member.

Flexible Staybolts.

Of the members who have replied, all except one member use flexible staybolts. Most of the members apply these in the breakage zone. Five members are making full installation of flexible staybolts on boilers with wide fireboxes. One member has the following report to make:

"In February, 1907, engine received new firebox with full installation of flexible staybolts, with the exception of four bolts, under the auxiliary dome and four under the steam turret; also eight bolts which go on top of same at back head. February, 1908, engine received general repairs and firebox was in good condition. All caps were removed from flexible staybolts and they were found to be O. K. April, 1909, it was found necessary to patch the top of the back tube sheet on account of sheet cracking from the hole around the flange; this was done in the engine house. October, 1909, engine was given general repairs, and by this time the top of back tube sheet had given out in two more places, but as the sheet was in good condition otherwise it was patched. Three of the mudring corners also had to have small patches applied. After rattling scale from firebox sheets with large hammer, it was found that forty (40) of the flexible sleeves had cracked outside of the sheet, and on being taken out they were found to be crystallized, but no broken bolts were found. In 1911 engine was again in the shop for general repairs and had all caps removed from flexible staybolts and bolts found to be O. K. A patch was applied on top flange of flue sheet, half side sheet seam in firebox in good condition. When engine is shopped again it will be necessary to renew back flue sheet on account of same being patched. This engine has made 319,567 miles to November, 1911, and has lost no time due to broken staybolts."

One member advises that his road has equipped some fireboxes with full installation of flexible staybolts, but can see no advantage in doing this. In their opinion the flexible staybolts are only advantageous when applied in the breakage zone, and they have discontinued making full installation and are only applying them in the breakage zone. However, a full installation of flexible staybolts in the throat sheet is being used by quite a few members with good results.

Three members advise that they allow a certain amount of slack when applying flexible staybolts. It is the belief that an application of this kind will decrease the number of broken staybolts and allow for a greater expansion and contraction, which prevents the cracking of firebox sheets and increases the life of firebox correspondingly.

The committee believes that this is a subject worthy of further consideration and would suggest that some more of the members carry on a further investigation and make a report at some future date to this Association.

Tube.

It is the consensus of opinion of those reporting that 2-inch tubes are preferred, until the length of tube exceeds 16 feet, when 2¼-inch tubes are then preferred.

Taking into consideration that a 2-inch tube will give a greater amount of tube heating surface, and the cost of maintenance is less, and less damage is done to the tube sheets in working over flues, your committee suggests that further consideration be given to the use of 2-inch tubes on lengths greater than 16 feet.

Thickness of Front Tube Sheet.

One-half inch and ⅝ inch being used by the majority of the members who replied to the circular. One member uses 9/16 inch and another uses ¾ inch.

Thickness of Back Tube Sheet.

One-half tube sheets are being used by sixteen of the members. Two members use 9/16 inch and one member uses ⅝ inch. All but three report having more or less trouble with flue sheets

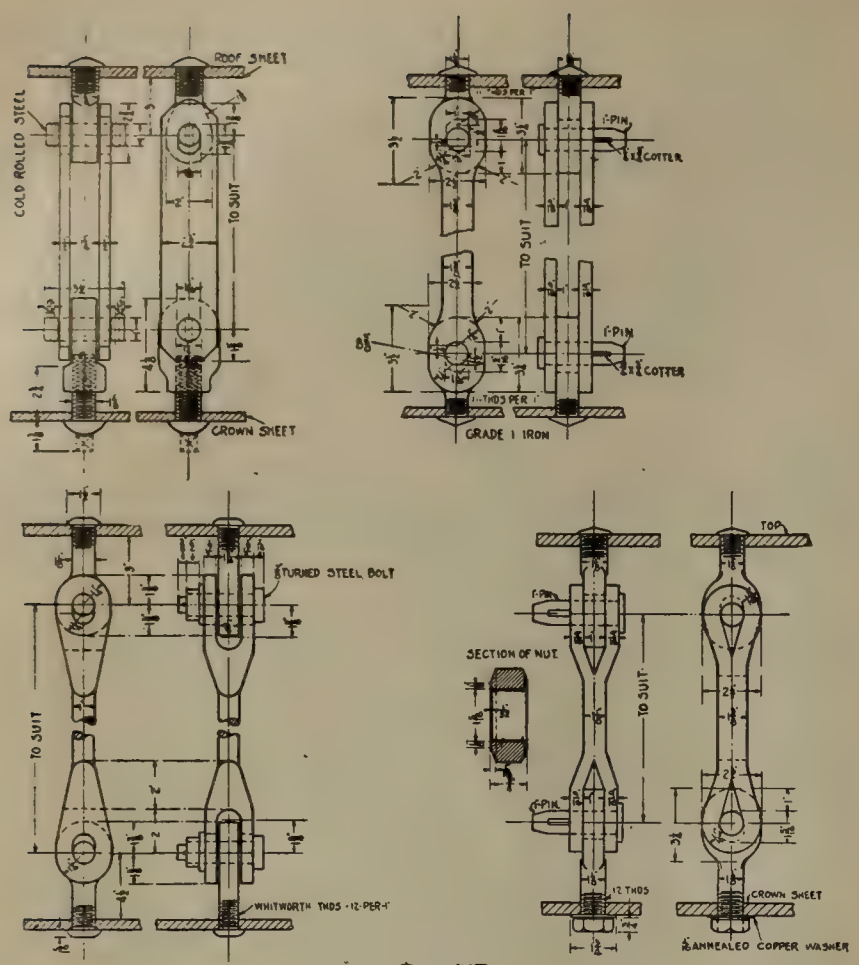


PLATE-V

Sling Stays.

working up on account of frequently working on the flues, causing the flue sheets to crack across the top of the flange of the sheet.

Width of Bridges.

Width of bridge in the front tube sheet varies from ½ inch to 15/16 inch. Three-fourth inch is used by the majority of the members.

Width of bridge in the back tube sheet varies from 11/16 inch to 15/16 inch. Three-fourths inch is used by the majority of the members.

Flue Setting.

Two members advise that they have tried out soft iron ferrules with very little success. One member advises that they had a limited experience trying to set flues in the back flue sheet without any coppers, but found that it did not work satisfactorily, and that they are now experimenting with a combined copper and iron ferrule, but have not had these under test long enough to make any report. One member advises that they use soft iron shims on the front flues to avoid excessive expanding.

Setting of Flues in the Front Tube Sheet.

The consensus of opinion of the roads reporting is that tubes should be rolled in the front tube sheet without any ferrules, and ten per cent of the flues, equally distributed, should be beaded with a beading tool.

Preparing Flue Sheets.

Holes in new firebox flue sheet shall be 1⅞ inch diameter. Holes

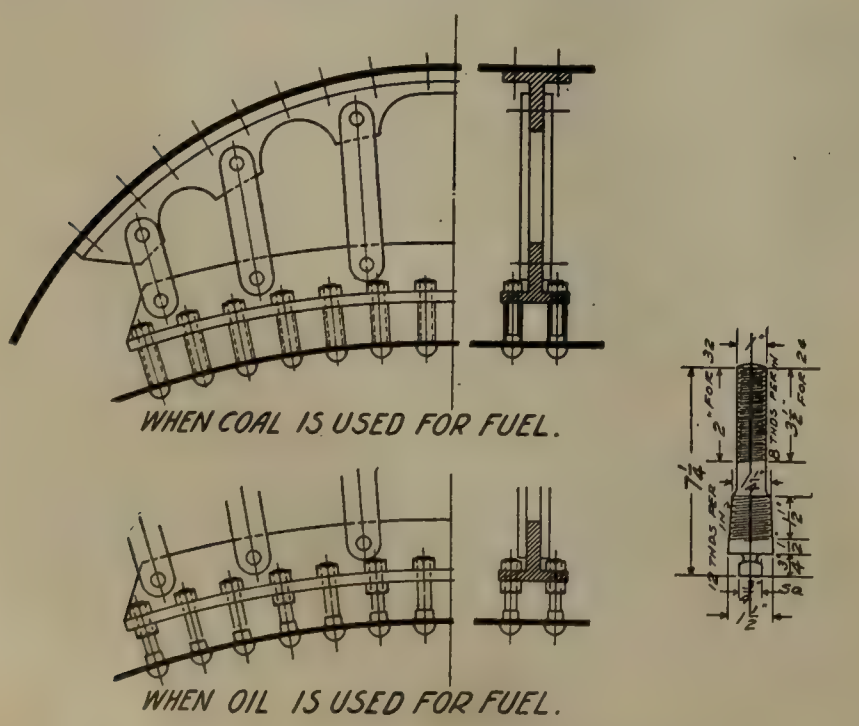


PLATE-VI.

Sling Stays.

in new smokebox flue sheet shall be 2 1/32 inch diameter. Holes in old flue sheet more than 1/32 inch out of round must be reamed, Plate Z-1. Inside and outside edges of flue boxes in both sheets must be slightly rounded to remove sharp edges.

Tubular Statement of Flue-Setting Method.

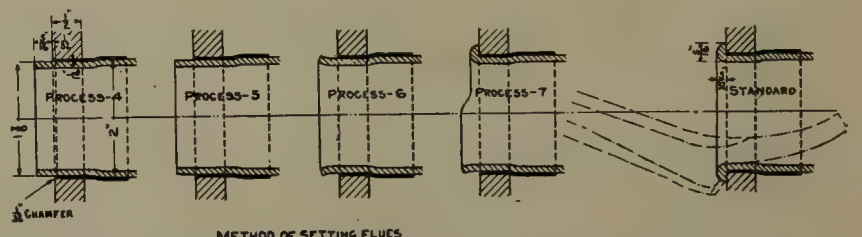
Back End.	Dudgeon roller by small air motor.
Expand copper ferrules.	Beading tool in air hammer.
Drive in flues.	Prosser expander.
Roll.	Front End.
Bead and caulk.	Shim.
Expand.	Roll.
Tool Used.	Dudgeon roller by air.
Prosser expander.	
Sledge and pin with collar.	

Flue-sheet Holes (Fig. 1)—Care should be taken that holes in flue sheet are true, smooth and free from burrs and sharp edges. It is desirable that the flue hole have a fillet especially on the water side, of about 1/32-inch radius. A sharp edge around the hole often cuts the ferrule in two, even cutting into the flue. The diameter of the flue hole should be the same as outside diameter of flue plus 1/32 inch.

Copper Ferrule (Fig. 2)—For new work this should not be far different from No. 16 B. W. G. In old flue sheets when the flue holes are large it is desirable to use enough heavier ferrules to bring the internal diameter of ferrule when expanded into flue sheet to ⅛ inch less than flue diameter. The ferrule should be set into flue hole flush with fireside and expanded into place with Prosser expander, Fig. 3.

Swaging Flue (Fig. 4)—Great care should be taken to give the swage the right length and to have it terminate in as abrupt a shoulder as possible. The flue, after it is swaged, should be annealed and the scale removed from the portion entering the sheet. Grinding this scale off by machine is desirable, but in the absence of a grinder the removal of the scale with a file will answer. The flue when driven into the sheet (Fig. 5) should extend 3/16 inch through the sheet on the fire side.

Rolling (Fig. 6)—The front end of the flues having been shimmed, when necessary, both the back and front ends are rolled with the dudgeon or other suitable roller, with proper appliances they may be safely and economically rolled by air; the rolling of



METHOD OF SETTING FLUES

1. ALL SCALE MUST BE REMOVED FROM FLUE HOLE BY SMALL AIR DRILL WITH SMALL EMERY WHEEL ON SHAFT OF DRILL.
2. ALL SCALE MUST BE REMOVED FROM END OF FLUE. THIS CAN BE DONE BY HOLDING A SQUARE FILE ON END OF FLUE WHILE BEING CUT TO LENGTH AND FLUE IS REVOLVING.
3. COPPERS OF PROPER THICKNESS INSERTED AND EXPANDED IN FLUE HOLE. EDGE OF COPPER SHOULD BE 1/32 FROM FACE OF FLUE SHEET. IN NO CASE SHOULD IT EXTEND THROUGH THE SHEET. BY BEING 1/32 BACK IN THE HOLE BEFORE ROLLING TAKES PLACE, IT WILL BE FLUSH WITH FIRE SIDE OF FLUE SHEET AFTER ROLLING.
4. FLUE INSERTED AND PINNED OUT.
5. ROLLED WITH ROLLER EXPANDER.
6. EXPANDED WITH PROSSER SECTIONAL EXPANDER.
7. BEADED WITH STANDARD BEADING TOOL.

NOTE:- FLUES SHOULD NOT BE TURNED OVER WITH PEANING HAMMER ON NEW SHEETS OR SHEETS OF FULL THICKNESS. HOWEVER IT MAY BE NECESSARY TO TURN THEM OVER IN OLD, THIN SHEETS.

PLATE-Z

the back ends must be done by an experienced boilermaker, and the motor must not be larger than a Thor No. 22 or its equivalent.

Beading (Fig. 7)—This may be done with a beading tool in an air hammer. Do as little hammering with the beading tool as possible, and do not work bead to a feather edge, but leave as much metal as possible for future caulking.

Expanding (Fig. 8)—Particular stress should be placed upon this, the most important step in the flue-setting process. Care should be taken that the flue shoulder when heavily expanded bears snugly and firmly against the flue sheet. Hammer not to exceed 4 pounds after prossering the front ends, then bead a sufficient number for safety which finishes the flue setting.

Back ends of flues or safe ends when used in back flue sheet must be cut off square in pipe machine and burr removed by reamer.

Wheel-flue cutters must not be used on account of leaving a heavy burr which splits when beading over.

Note.—Air motor and roller are only to be used on initial setting. In removing flues, the Prosser expander only is to be used, and rollers must not be used, as they force the bead away from the sheet.

Applying Copper Ferrules.

Copper ferrules 1¾ inch inside diameter, ½ inch long, .095 inch in thickness shall be used in firebox flue sheet only. Ferrules shall be secured in place with straight expander (Fig. 2), taking care that shoulder of expander is tight against flue sheet, which shall bring edge of ferrule 1/32 inch from fire side of sheet.

Preparing Flues.

Flue safe ends should be five inches in length, except that new iron flues shall have safe ends 4 inches long, and when these flues are first removed the 4-inch ends will be cut off completely and 6-inch ends applied, after which 5-inch ends should be used. Flues shall be swaged as per Fig. 4, to 1 11/16 inches outside diameter by 3 inches long, including taper at firebox end, for new work; for old work, just enough to enter the copper ferrule. All scale must be removed from swaged ends of flues before application. Smokebox end of flues shall not be more than 1/32 inch less in diameter than holes in the smokebox flue sheet. If necessary, liners may be used.

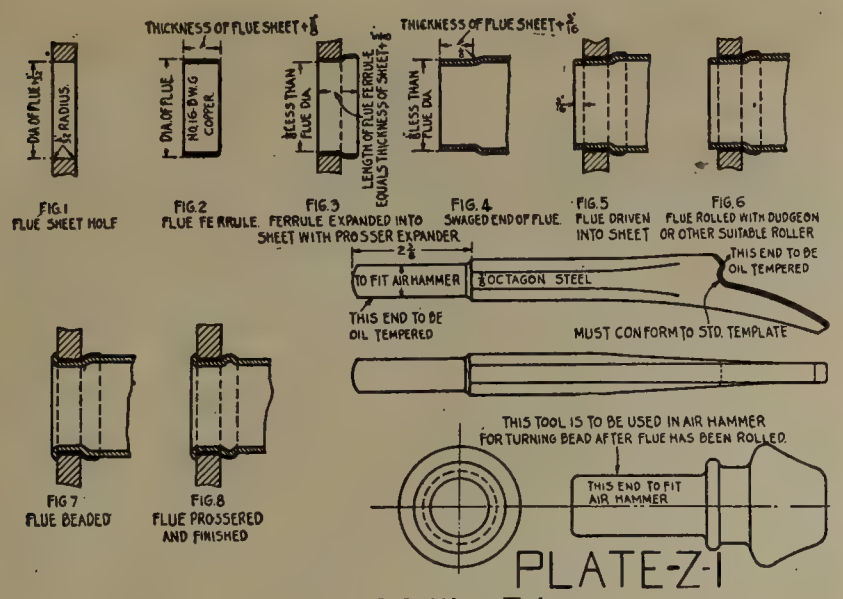


FIG.1 FLUE SHEET HOLE
FIG.2 FLUE FERRULE.
FIG.3 FERRULE EXPANDED INTO SHEET WITH PROSSER EXPANDER
FIG.4 SWAGED END OF FLUE.
FIG.5 FLUE DRIVEN INTO SHEET
FIG.6 FLUE ROLLED WITH DUDGEON OR OTHER SUITABLE ROLLER
FIG.7 FLUE BEADED
FIG.8 FLUE PROSSERED AND FINISHED
TO FIT AIR HAMMER
OCTAGON STEEL
THIS END TO BE OIL TEMPERED
MUST CONFORM TO STD. TEMPLATE
THIS TOOL IS TO BE USED IN AIR HAMMER FOR TURNING BEAD AFTER FLUE HAS BEEN ROLLED.
THIS END TO FIT AIR HAMMER
PLATE-Z-1

Method of Setting Tubes.

Fastening of Flue in Flue Sheet.

Flues shall be placed in back flue sheet with a bar, Fig. 5, and project ¼ inch through the sheet. Gage (Fig. 6) shall be used in checking location of flues. Flues shall then be fastened at firebox end with straight sectional expander (Fig. 7). While flue is being fastened it may be held in place at front end, using bar (Fig. 5). Straight sectional expander shall be checked with master gage (Fig. 8). Before using sectional expander, and in order to obtain exactly the proper length of flue for beading, flues may be rolled lightly to fasten them in sheet with roller expander (Fig. 15). After all flues are fastened they shall be flared at firebox end, using flaring tool (Fig. 9), and long stroke riveting hammer.

Expanding Flues.

Flues at firebox end shall be expanded with sectional expander (Fig. 10), and long stroke riveting hammer. Roller expander must not be used. Pin shall be driven into expander until flue is solid against flue sheet. This must be done three times, expander to be slightly turned before each operation. The expanding shall be performed as follows: First, two vertical rows, from center to top of sheet. Second, same rows from center to bottom. Third, the two horizontal center rows from center to right. Fourth, same rows from center to left. Fifth, all remaining flues. All flues must be carefully inspected after expanding to assure that recess in each flue is the full depth of recess in expander and even all around the flue. Sectional expander (Fig. 10) to be checked with master gage (Fig. 11).

Beading Flues.

Flues in firebox flue sheet shall be beaded with standard beading tool (Fig. 12), and short stroke riveting hammer. Care must be taken so that nothing enters between head and flue sheet. Beading tool must conform accurately to master gage (Fig. 13) at all times. Smokebox end of flues shall be tightened with flaring tool (Fig. 14) before rolling takes place. All flues in smokebox end shall be rolled with roller expander (Fig. 15).

Flue Maintenance.

The firebox end of flues in service must be expanded at regular intervals with sectional expander (Fig. 10). This work shall be done when boiler is empty and all flues thoroughly cleaned out. Flue leaks in the firebox must be stopped with the sectional expander and not with roller expander nor beading tool. If beads are slightly away from flue sheet, standard beading tool shall be used to bring beads tight to sheet.

Sectional expanders and beading tools must be kept standard by frequently comparing with standard gages. Any beading tool not conforming to gage must be sent to principal shop for repairs; these tools must not be repaired at any other shop.

All shops and engine houses must be equipped with standard gages. All gages will be made where master gages are kept.

To remove flues, use flue cutter (Fig. 16) for the front end, cutting off flues as close to the front flue sheet as possible. Back ends should be split as little as possible, so that it will not be necessary to use safe ends longer than 5 inches.

Setting of Superheater Tubes.—Front Tube Sheet. Only eight members have had any experience with setting large superheater tubes. The practice followed out mostly is that the tube is rolled and beaded as shown on Plate Z-2, and this type of setting is suggested by your committee for further consideration.

Back Tube Sheet.—Eight members advise that they use copper ferrules; one member who omitted copper ferrules is having good success with this method.

The consensus of opinion of the roads reporting is that the type of setting shown on Plate Z-2 is preferred, and your committee suggests this setting, except that the copper ferrules should be No. 13, .095 inch thick, instead of No. 16, .065 inch thick.

Circulation of Water.—Your committee took up the question with the members whether any of them employed any special feature of design to facilitate circulation of water. We find that no member has any special design for this purpose. Four members advise that they use baffle plates in the boiler shells, located ahead and rear of the dome. This is to prevent, as much as possible, the water from surging when making quick stops.

The committee has no recommendation to make in regard to the use of baffle plates.

Seventeen members deliver feed-water to boiler in the first course on the horizontal center line. The distance from the front flue sheet varies; the minimum distance is 22 inches and the maximum 6 feet. Five members advise that they deliver feed-water to the boiler through the top as well as from the side. One of these members advises that they have never been able to find any particular improvement which the top check has over the side check. Two of these members prefer the water to be fed into the boiler from the top. Boilers having the checks on top of the boiler have a pan-shape deflector under the check valve which catches the water and prevents any direct stream of water falling on the top of flues. One member advises that they deliver the feed-water in the first course on the horizontal center line and use a deflector plate placed a short distance away from the boiler course. This is to direct the water to the bottom without striking the tubes. Four

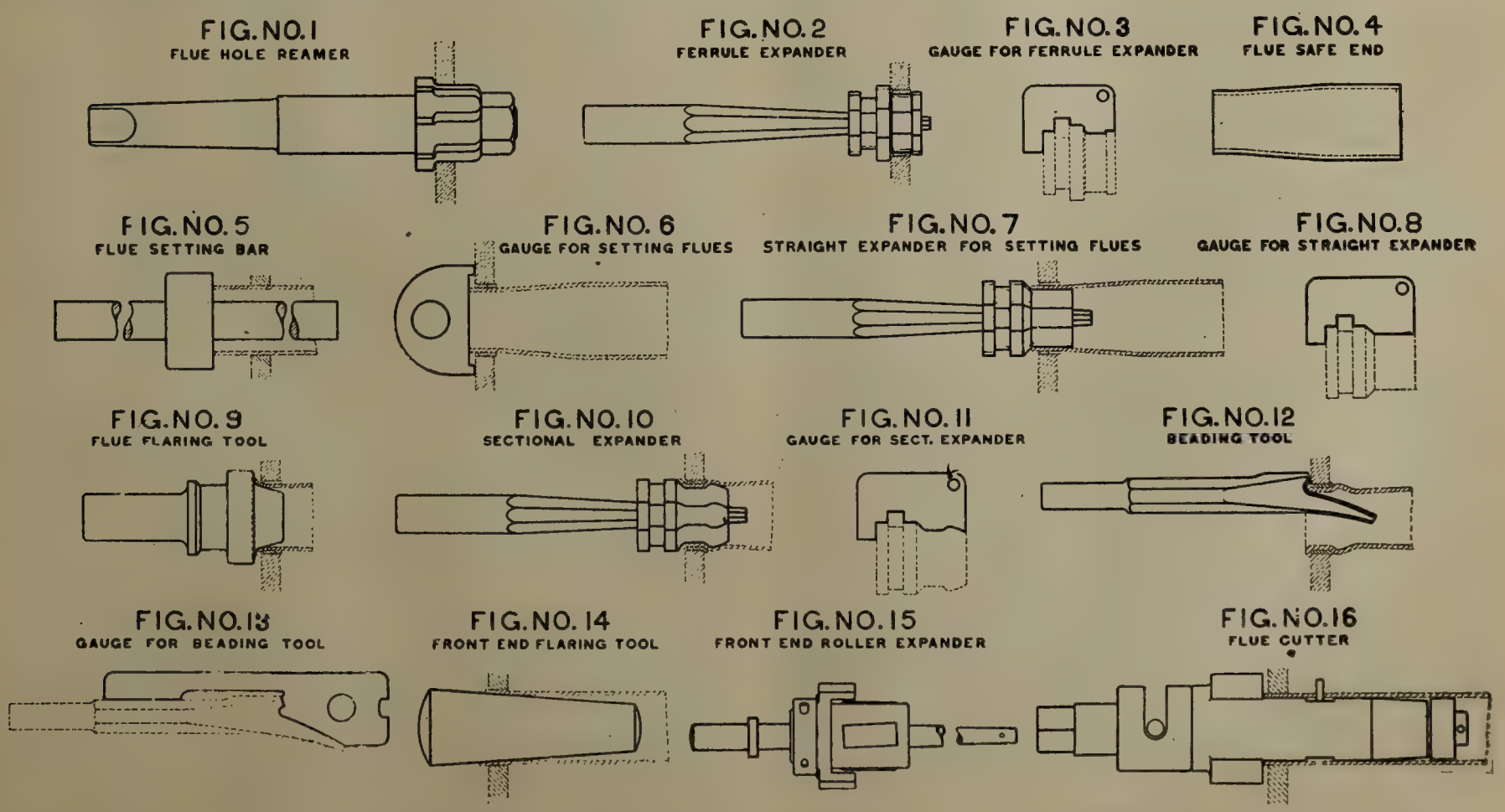


FIG.NO.1 FLUE HOLE REAMER
FIG.NO.2 FERRULE EXPANDER
FIG.NO.3 GAUGE FOR FERRULE EXPANDER
FIG.NO.4 FLUE SAFE END
FIG.NO.5 FLUE SETTING BAR
FIG.NO.6 GAUGE FOR SETTING FLUES
FIG.NO.7 STRAIGHT EXPANDER FOR SETTING FLUES
FIG.NO.8 GAUGE FOR STRAIGHT EXPANDER
FIG.NO.9 FLUE FLARING TOOL
FIG.NO.10 SECTIONAL EXPANDER
FIG.NO.11 GAUGE FOR SECT. EXPANDER
FIG.NO.12 BEADING TOOL
FIG.NO.13 GAUGE FOR BEADING TOOL
FIG.NO.14 FRONT END FLARING TOOL
FIG.NO.15 FRONT END ROLLER EXPANDER
FIG.NO.16 FLUE CUTTER
PLATE Z-3

Flue Setting Processes.

members have an attachment on the inside of the injector check to deliver water upward away from the tubes. One member advises that in addition to circulating water from the horizontal line of the boiler they have some locomotives with the delivery pipe passing through the back head, extending from 3 feet to 6 feet from the front tube sheet, and the end of the pipe set to deliver water towards the side of the shell; the end of the pipe is submerged.

The committee has no recommendation to make in regard to any particular location where the water is to be delivered to the boiler, as any of the above arrangements seem to give entire satisfaction.

One member advises that they provide an auxiliary dome, or manhole, for interior inspection of boiler. The size of manhole is 15 inches in diameter, located a short distance ahead of the back flue sheet. This is submitted for your consideration, as it makes inspection of the interior of the boiler possible without removing the throttle standpipe and dry pipe. One member of the Association is using larger dome in new construction to accomplish the same result.

Three members use surface blow-off cocks. One of these members has discontinued the use of same, the other two members using surface blow-off cocks have located them on a line with the second gage cock, and advise that they get good results from the use of both the blow-off cock and surface blow-off cocks by getting rid of the mud and scale by blowing the boilers regularly.

We find there is no uniform practice in regard to the location of blow-off cocks. Two members advise that they use four or more blow-off cocks, which are located one in the throat sheet, one or more in the side water legs, depending upon the size of the boiler, one in the belly of the boiler near the throat sheet, and in some cases additional blow-off cocks in the belly of the boiler at the center. One of these members advises it has been found by using a sufficient number of blow-off cocks and insisting upon their use at regular intervals the amount of boiler washing has been cut down considerable, as well as giving greater life to the flues. Another member advises that they have been experimenting with the blow-off system, by which one blow-off cock in the throat sheet draws mud from along the mud ring and the barrel of the boiler by means of slotted pipes, and this has worked out satisfactorily in service. Some of the members favor locating the blow-off cock right above the mud ring and another locates them about one foot up from the mud ring.

Your committee has no recommendation to make in regard to the number or where the blow-off cocks should be located. The number and location of blow-off cocks depends on the quality of water used.

It seems to be the consensus of opinion of the members that it is most advisable to fill the boilers from the blow-off cocks in the water leg, providing warm water is used. If cold water is used it should be filled through the valve on top of the boiler or through the injectors, and your committee recommends that this practice be followed out.

(Signed) D. R. MacBain,
C. E. Chambers,
T. W. Demarest,
F. H. Clark,
R. E. Smith,
J. Snowden Bell,
E. W. Pratt.

Discussion.

C. A. Seley: Before the discussion, I would like to refer to the president's report with respect to conferring with the federal inspectors. Such a conference is being arranged for and a committee of 12 members will be appointed. A bulletin will shortly be sent to the various railways urging them to make suggestions.

F. F. Gaines: I have found that the large mud ring radius is not altogether desirable and have gone back to the small radius. I notice the general practice is to use arch tubes, .18 inch thick, but I have obtained better results from .15 inch. I have found a small radius better in the flange in the back tube sheet. With regard to circulation of water, I find that the wide water leg with large water space has not proven as good as the narrow. Of two engines exactly alike, the one with the smaller water space is the much freer steamer, although a little harder on staybolts.

M. H. Haig: In oil burning engines the stay has no button head, but is screwed in and riveted over, the taper being 1⅜ inches in 12. Oil burners are generally harder on fireboxes than coal burners. This stay is very satisfactory with oil burners, and surely should be with coal burners. Speaking of the mud ring would say that one road uses a heavy boss at each corner. A large dome for inspection is a very favorable recommendation.

D. P. Kellogg: We are using the screwed rigging in oil burners, using 1½-inch taper and have had good results. We put a thimble on the crown bar bolt which goes up against the crown bar. Lately we have applied this without riveting.

W. E. Dunham: We have been using No. 7 and No. 10 gage arch tubes in both iron and steel in the bad water districts, but do not find much difference. I know of two members who have increased the radius of the flange and have again decreased it. We consider radial button head stays with hammered heads a matter of safety, and believe they should be used.

J. F. DeVoy: In our first oil burners we did not protect seams and rivets, but they are now being protected. Perhaps the committee could devise a method of protecting them by the use of brick. The button head sling stay is the only thing to use on an oil burner.

W. J. Tollerton: With regard to scarfing of riveted seams, we have been doing this for about four years, and know it eliminates cracking out. I believe it a great advantage.

Wm. Forsyth: Mr. DeVoy suggests protecting seams with fire brick. The Santa Fe has used a submerged seam, and that probably led to the Jacob-Shupert firebox. It seems queer that this firebox has received no attention in this report.

S. L. Bean: We tried out submerged seams thoroughly. We find that they work fine with the door sheet. On the flue sheets, the vertical expansion takes place and the crown sheets will crack right across. Seam brick helps out, but we only use it to prolong life of firebox. We have extended the service of an oil burning firebox from 18 months to 7 years, and I recommend the taper radial stay. With reference to the large flange in the flue sheet, we found with a shorter flange that pitting takes place much quicker.

E. W. Pratt: Do you use a crown bar thimble on oil burners?

S. L. Bean: We use three in each row.

J. A. Pilcher: We have been making experiments with water spaces as wide as 7 inches. We have applied this to between 150 and 200 locomotives and find the effects very favorable.

F. F. Gaines: I would like to ask how long before we can look for trouble after changing from oil burning to coal burning.

D. P. Kellogg: You want nothing projecting into the firebox of an oil burner.

J. F. DeVoy: I agree with Mr. Kellogg. We use a slight button head and patch all boxes with brick.

W. J. Tollerton: For Mr. Gaines' information, I would say that the cracking will occur above the brick. Broken glass thrown on top of the brick will help very much.

E. W. Pratt: No report was made by any member of the committee concerning the Jacobs-Shupert firebox. This report covers the reports of all railways which sent us information. With regard to evaporation, I do not think the addition of two feet on the end of the flue would result in much gain. We made some experiments and found that the back flue sheet on one of our engines moved up from ⅝ of an inch to ¾ of an inch in a year. We have over 1,200 locomotives equipped with the O'Connor fire door flange, and find it very satisfactory. We are new in oil burning but find that the front end burner is giving us trouble with the door sheet.

F. J. Harrison: Do you find an accumulation of mud around this door sheet?

E. W. Pratt: We do not, and we find a good circulation on account of the large water space.

Angus Sinclair: On the Harriman lines they have an instrument so constructed that if water goes off the crown sheet, a whistle will blow.

D. P. Kellogg: We had this apparatus in use on our lines. It is operated by a difference in temperature by securing water in a cup. When the water falls, steam enters and expands the mercury. With an oil burner, the oil is shut off, and with a coal burner, water is sprayed on the fire.

M. H. Haig: I note the feed water is delivered through a perforated pipe, falling on a plate above the tubes, the claim being that cold water does not settle down so readily. One of these devices was placed on a road in the west several months ago and the road foreman of engines says that less coal and oil has been used.

C. E. Chambers: Combustion chambers undoubtedly aid the steaming of an engine. However, it means drawing the fire once a week, and boring out the bottom flues. It also reduces the number of flues in the boiler. We went from the combustion chamber a few years ago to the D flue sheet and are applying it at this time. We tried out the scarfing of seams very thoroughly on our road and obtained very good results.

F. F. Gaines: You can always remove sparks and other matter deposited in the combustion chamber. There is a coal economy of 15 per cent and the flue economy is much more than that. Also with the soft coal engines, it eliminates smoke and sparks. In a short experience of six weeks with the superheater, I have not found it necessary to blow the flues.

D. H. Deeter: After building 75 locomotives with the wide firebox, we found that with the amount of service required, they would not carry water properly. We had trouble with the bottom of the combustion chamber becoming burned out. After trying these engines for 15 years we decided to put on straight wrapper sheets. I find that the combustion chamber is economical as to fuel and that the life of a firebox is about 8 years.

C. E. Chambers: At present we are building engines both with the combustion chamber and without.

J. T. McGrath: We are not contemplating changing the design of boilers on the Chicago & Alton. I am, however, much interested in the combustion chamber and the welding of tubes.

F. T. Slayton: If we could weld in tubes it might overcome some of our troubles. Three months ago we took an engine in yard service with which we had been having trouble and welded in the flues. Since then we have had no trouble. This has been done with other engines with very good results.

Thos. Roope: We weld flues on Mallets with double boilers. The engines have been running a year and so far have been very successful.

C. A. Seley: I do not think the committee should be criticised from matters omitted, as they have given us a great deal of information.

Prof. W. F. M. Goss: I believe that much depends on related details, and the conclusions of the members responding should be carefully analyzed before making a standard practice. The development of the last few years has been toward wide water spaces, but this has been carried too far. Problems are changing from year to year. Some of the proposals now being put forth, as the Jacobs-Shupert box, are of great interest.

G. H. Baker: There never has been a committee to consider the management in operation of locomotive boilers.

F. F. Gaines: I move the discussion be closed and the suggestions for the new committee be considered.

E. W. Pratt: I would like to have the new committee include Mr. Baker's suggestion and the committee make report on operation, maintenance and repairs of locomotive boilers. The motion as amended was carried.

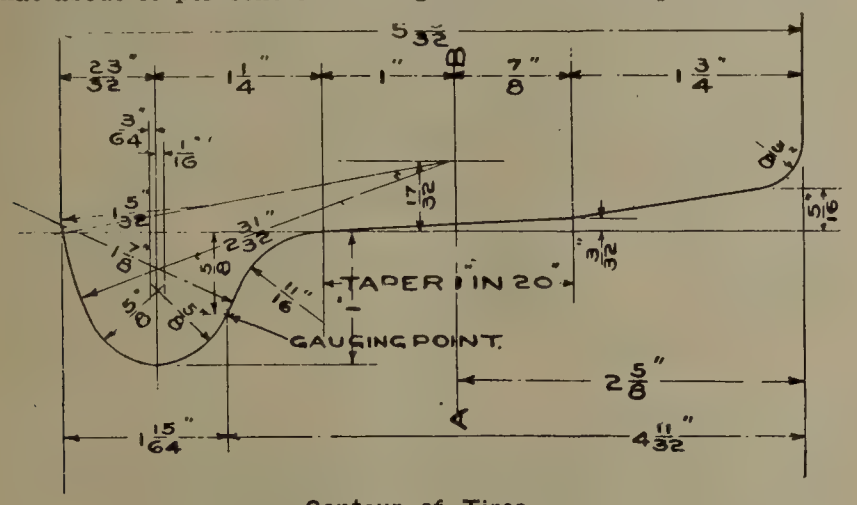
CONTOUR OF TIRES.

The committee on contour of tires has been instructed to look into the various points brought out in the discussion at the last convention and, if possible, recommend a contour of tire that would be most economical in all services; also, recommend a minimum thickness of flange for re-turned tires.

The discussion at the 1911 convention was confined to the proposed reduction in height of flange from 1⅛ inches to 1 inch, the taper of tread, and the question of limit of flange thickness of less than 15/16-inch.

After considering the repiles received to our circular of inquiry and such other data as were available, your committee is very strongly of the opinion that the M. C. B. recommended contour of tread and flange for steel wheels should be used for engine and tender truck wheels. To a very large extent in ordering wheels it is not specified whether for tender trucks or cars, no distinction being made as between the two. It is of distinct advantage to the railroads to keep down the number of standards manufactured as insuring more prompt filling of orders and a smaller stock on hand at their own shops. Car, tender and engine truck wheels are, as a rule, turned up on the same machine, and most shops are provided with special tools for dressing the flanges and treads. To require different tool equipment for different wheels would be objectionable and confusing. In fact, when wheels are being machined it is not generally known whether application will be made to cars or tenders. Your committee, therefore, recommends for engine and tender truck wheels in all classes of service the contour of tread and flange as shown in the drawing. This contour is the same as will be recommended to the M. C. B. Association in June, 1912, and differs from the present M. C. B. recommended contour in that additional metal has been added to the back of the flange, making the contour of the flange identical with the flange for cast-iron wheels. This thickening of the flange was recommended with the view of increasing the life of the wheel, as many steel wheels are now withdrawn from service due to thin flange.

Replies received from the manufacturers of steel wheels indicate that about 80 per cent of the engine truck and 95 per cent of the



Contour of Tires.

tender truck wheels manufactured during the past year are of the 1909 M. C. B. recommended contour.

In driving-wheel service the conditions are somewhat different, as the brake shoes generally used are recessed for the flange, and also opposite that part of the tread coming in contact with the rail. This tends to keep down the height of the flanges and retards channeling of tread. On account of the general opposition to any reduction in flange height of driving wheels in road service and the fact that the present A. R. M. M. A. standard contour of tread is so nearly like the M. C. B. 1909 contour, your committee does not feel justified in recommending, at the present time, any change from the present contour, for driving and trailing wheels of locomotive in road service. As a matter of information, we wish to add that while practically all railroads are using a contour of driving-wheel tire approximating the A. R. M. M. A. standard, almost all are deviating in some particular.

In the case of switching locomotives it is felt that a flange 1 inch in height is perfectly safe and will be more satisfactory than the present standard, as a greater mileage can be made with the shorter flange before reaching an objectionable height. As has been previously mentioned, the A. R. M. M. A. and M. C. B. contours of tread being so nearly alike, it was felt unwise to establish a new contour having the M. C. B. flange and A. R. M. M. A. tread, and we, therefore, recommend the contour shown in Fig. 1 for driving-wheel tires in shifting service.

The six widths of flanged tires shown on Sheet 1 of the standards are, in your committee's opinion, entirely unnecessary, and we would recommend that one width be shown; namely 5½ inches. In the case of plain tires, three sizes as recommended last year are sufficient; the two sizes 6¼ inches and 6¾ inches to be eliminated.

As concerns condemning thickness of flange below 15/16 inch, after carefully considering the replies received and all information available, we can not see our way clear to recommend flanges of wheels under locomotives and tenders being allowed to remain in service when worn below this limit.

Our recommendations, therefore, are as follows:

Recommendations.

Engine truck wheels, contour as shown in the drawing.

Tender truck wheels, contour as shown in the drawing.

Flanged driving-wheels and trailing-wheels of locomotives in road service, present A. R. M. M. A. standard of 5½ inches in width.

Flanged driving-wheels in shifting service to be as shown in the drawing.

Plain tires, present A. R. M. M. A. standard, three widths, 6 inches, 6½ inches and 7 inches.

Condemning limit of thickness of flange, 15/16 inch.

(Signed)

W. C. A. Henry,
J. A. Pilcher,
O. C. Cromwell,
O. M. Foster,
H. C. Oviatt,
G. W. Seidel.

Discussion.

E. W. Pratt: I think there is considerable time spent in turning tires to gain a double taper, and we don't gain anything by it. In returning tires there should be a minimum flange allowance.

F. F. Gaines: Some years ago we had records kept on the cost of turning steel tire wheels. When the tire commenced to wear on the flange, we found it best to turn it. With regard to the height of flange, last year I went home and had the tires of some road engines turned up with a one-inch flange. These have been in general service and nothing has happened to them. I would like to have more roads see if it is not possible to adopt one-inch flange height.

M. H. Haig: I would like to point out a feature in which we are wasting a certain amount of metal. Recommendations call for a taper in the thread of one-inch in 20. This, I understand, was based on having a small diameter of one wheel on one rail, and a larger wheel diameter on the other rail. I do not think that this always holds, as there are times when the leading driver flange is drawn to the inner rail while rounding a curve. When an engine has been in service for some time, the thread becomes worn to the shape of the rail. The contour should be based on the shape to which the tire is worn in service. Some manufacturers of locomotives, unless otherwise specified, will turn new tires with cylindrical thread instead of conical.

Robt. Patterson: I am not convinced that we should turn our driving tires tapered. If wheels are turned up in the same shop for both car and locomotive departments, I think that is desirable. We, however, run our departments separately ,and don't see any reason why we should turn driving tires tapered for locomotive work. The taper does not last. We abandoned the practice 35 years ago and see no advantage in it.

W. C. A. Henry: The question of the economical limit was discussed by the committee, but it varied so that it was impossible to recommend a limit that had any meaning. The taper of the tread keeps the flanges from the rails at the beginning and starts them running right.

C. E. Chambers: The life of a tire depends on whether it starts right. In several classes of service we could save money by not trying to build up a full flange on wheels. Removing tires cost very little.

F. J. Harrison: We are turning everything with the one-inch flange, and see no reason why an engine wheel won't run with it. I don't think many are running driving tires, with a ¾-inch flange.

E. A. Miller: Conditions under which engines work have considerable to do with the flange. We had a one-inch flange for many years, then went to ¾-inch and had trouble from derailments. Think we should start engines with taper tires, but brake shoes rapidly change it.

John Tonge: We quit turning tapper on tires 30 years ago. Have had no difficulty on Mogul engines, but have found difficulty on 10-wheel engines.

E. W. Pratt: A few years ago we decided to use ⅞-inch flange on switch engines, but found we have more derailments, and went to a one-inch flange.

C. E. Chambers: I would like to know more about the thickness of tires.

F. J. Harrison: About two years ago we used an inch and a half thickness; from that it went to 1¾-inch, and now we are getting to 2⅛-inch.

John Tonge: I know of no way to save money faster than by taking care of tires. I have seen engine truck wheels changed in 20 minutes.

F. F. Gaines: I move that the recommendations of the committee be submitted to letter ballot, the items to be balloted on separately.

INCREASED POWER WITH SUPERHEATED STEAM.

By C. H. Benjamin and L. E. Endsley.

It is with regret that we have to say that we are unable at this time to make a full report to this convention upon the results obtained on the Purdue locomotive in regard to the increased power obtained with superheated as compared with the maximum power obtained with saturated steam. This is due to the fact that laboratory conditions were such that all the tests of the series could not be completed until so late a date that sufficient time was not available to make a full report.

It was thought worth while, however, to make some statement in regard to the progress of the work, and, in a general way, to indicate to what extent the power of the locomotive was increased by the installation of a Schmidt superheater, which gives a rather high degree of superheat.

It will be remembered that the work reported upon for the last three years was a comparison between the efficiency of the locomotive when using first, saturated steam, and then superheated steam, while developing approximately the same amount of power under both conditions. When the maximum power was obtained upon the locomotive, while using saturated steam, it required the burning of from 120 to 130 pounds of coal per square foot of grate area per hour, whereas when superheated steam was used, and when approximately the same power was developed, only from 85 to 90 pounds of coal per square foot of grate area were burned. This difference in the amount of coal burned while operating with saturated and superheated steam, respectively, is due to the fact that about twenty-five per cent saving was made in the amount of coal burned.

The work this year has consisted in increasing the power by increasing the cut-off by small increments in an endeavor to burn the same amount of coal per square foot of grate area per hour, as was done while using saturated steam. While we have not up to this time increased the cut-off to such an extent as to make this possible, it is apparent that there will be no great difficulty in burning the same amount of coal. When these tests are completed, it can then be determined to what extent the power has been increased and by what amount the efficiency has been affected. It is evident that if this increase in the amount of coal burned can be effected without decreasing the efficiency of the locomotive, the per cent of gain in power will be even greater than the per cent of gain in the efficiency of the locomotive when using superheated steam than when using saturated steam. The tests made so far, however, indicate that there is a slight decrease in efficiency with increased burning of coal, so that a gain of not more than twenty or twenty-five per cent in power may be anticipated.

Discussion.

Prof. Endsley: Since this statement was made tests have been carried far enough to indicate that the efficiency of the cylinder due to the increased cutoff has decreased, and we are only getting an increase in power of about 16 per cent. That is the efficiency of the cylinder as a separate unit has decreased 16 per cent. The increase of steam necessary to develop the horsepower has gone up about 15 per cent and was brought about by dropping the reverse lever down to a running cutoff of about 14 notches. We are figuring to finish the tests with this cylinder and then increase the diameter by about 25 per cent. Of course, if we increased the size on a road engine we would have a "slippery" engine, but in this test we are not interested in the slipperiness of the engine. The efficiency of the cylinders at from 160 to 200 pounds pressure is about the same, so we can decrease the pressure to 160 pounds and get the same service. Next year we shall make a full report as to what we can get out of the larger cylinders.

W. F. M. Goss: The present testing plant has been in operation 21 years and I think this is the time for a new one. I hope that means will be granted to Prof. Endsley to continue this work.

C. D. Young: If the piston speed is low and the cutoff long, no economy is obtained in superheating. With regard to obtaining the same amount of power with a 40-pound reduction in boiler pressure. This would mean that cylinders would have to be kept down to 27 inches or 28 inches in diameter. I think that next year a thorough range of modern boiler pressure should be considered, as the designer must know this in order to design the cylinders.

Prof. Endsley: We will do work at 160 lb., 200 lbs., and even as low as 120 lbs. We may also do work at 240 lbs. and expect to cover the entire field.

C. A. Seley: I move that a vote of appreciation be given Prof. Endsley.

The motion was carried.

STEEL TIRES.

Since the last convention, your committee, which was continued with a view to presenting a specification from which railway companies could purchase tires, with confidence that they would give the service expected, have worked to that end, and although it would be impossible to construct a specification every clause of which would meet with every member's ideas, and also fill in detail all the ideas of every member, we feel we have a good working specification, which, if followed by the manufacturers, will produce tires which will give satisfactory service on any road on this continent. It is a little longer perhaps than we would have liked; at the same time, we, as a committee, hardly see where we can shorten it, and get the results required.

Recognizing the importance of a drop test, we have gone to considerable trouble in getting the very best practice of the old and new worlds, but as you will see, clause 8 leaves it optional with the railway companies to demand or not as they wish. The rules for the drop test have been drawn up with the idea of utilizing as far as possible the drop-test machines already in use for other purposes, and so sparing the manufacturers the expense of making special ones for tires.

(Signed) L. R. Johnson,
R. L. Ettenger.
J. R. Onderdonk.
C. H. Hogan.
L. H. Turner.

Specification for Steel Tires.

1. Material.—Stock for tires shall be made by the open-hearth or crucible process.

2. Classes.—There will be three classes of tires for the different classes of service as follows:

Class 1. Driving tires for passenger engines.
Class 2. Driving tires for freight engines.
Class 3. Driving tires for switching engines, and tires for engine truck, tender truck, trailers and car wheels.

3. Chemical Composition.—

Class 1. Carbon not less than..50 per cent or over 70 per cent
Phosphorus, not over..05 per cent
Manganese between....50 per cent and 80 per cent
Sulphur, not over.....05 per cent

Class 2. Carbon, not less than..60 per cent or over 80 per cent
Phosphorus, not over..05 per cent
Manganese between....50 per cent and 80 per cent
Sulphur, not over.....05 per cent

Class 3. Carbon, not less than..70 per cent or over 85 per cent
Phosphorus, not over..05 per cent
Manganese between....50 per cent and 80 per cent
Sulphur, not over.....05 per cent

4. Finish.—The tires must be free from defects of any kind, and finished tires must be accurately machined to the prescribed dimensions of the Master Mechanics' standard, and rough tires must not be outside the limits of the attached prints.

5. Branding.—The tires shall be distinctly stamped when hot with such brands as the purchaser may require, and in such a manner that those marks shall be legible when the tires are worn out.

6. Samples for Chemical Analysis.—Drillings from a small test ingot cast with the heat, or turnings, from a tensile specimen, or turnings from a tire (where tires are machined at the works of the manufacturer) shall be used to determine whether the chemical composition of the heat is within the limits specified in paragraph 3. When required, the purchaser or his representative shall be furnished an analysis of each heat from which tires are made.

7. Physical Properties.—The steel for the different classes of service shall meet the following minimum physical requirements:

Class.	Tensile strength. Lbs. per sq. in.	Elongation per cent in 4 inches.
(a)	105,000	Quotient of 1,556,000 divided by the tensile strength.
(b)	115,000	Quotient of 1,300,000 divided by the tensile strength.
(c)	125,000	Quotient of 1,150,000 divided by the tensile strength.

8. Falling Weight Test.—Should the contract call for a falling weight test, a test tire from each heat represented shall be selected by the purchaser or his representative and furnished at his expense, provided it meets the requirements.

8a. The test tire shall be placed vertically under the drop in a running position on a spring foundation with an anvil of at least ten tons weight, and shall be subjected to successive blows from a tup weighing 2,000 pounds falling from heights of 5 feet, 10 feet, 15 feet and 30 feet and upwards, until the required deflection is obtained as specified in paragraph 8b.

8b. The test tire shall stand the drop test described in paragraph 8a without breaking or cracking and shall show a minimum deflection equal to X in the following table:

Internal diameter of tire (equal D). Thickness of tire (equal T).	Class No. 1. Tensile breaking strength per sq. in., 105,000 lbs.	Class No. 2. Tensile breaking strength per sq. in., 115,000 lbs.	Class No. 3. Tensile breaking strength per sq. in., 125,000 lbs.
3 feet diameter and over..	3d	3d	3d
	—	—	—
	6t	10t	12t
Under 3 feet diameter....	3d	3d	3d
	—	—	—
	10t	12t	14t

8c. A specimen for the tensile test is to be taken from a tire that has been subjected to a falling weight test, and it shall be cut cold from the tested tire at the point least affected by the falling weight test. The tensile test specimen when cut from a tire that has been subjected to a falling weight test shall be cut normal to the radius and parallel to the face.

8d. Should the test tire fail to meet these requirements in any particular, two more test tires shall be selected from the same heat if the manufacturer so desires, and at his expense. Should these two tires fulfil the requirements, the heat shall be accepted.

9. Inspection.—The inspector representing the purchaser shall have free entry to the works of the manufacturer at all times while his contract is being executed. All reasonable facilities shall be afforded to the inspector by the manufacturer to satisfy him that the tires are being furnished in accordance with the specifications. All tests and inspections shall be made at the place of manufacture prior to shipment, and shall be conducted so as not to interfere unnecessarily with the operations of the mill.

Tires must be rolled in accordance with the best practice, sufficient metal being discarded to insure sound tires. The tire taken from the bottom of the ingot must be stamped with the letter "A," before the tire number, the next above "B," and so on up the ingot.

Tensile test specimens, one from each heat, must be forwarded to the engineer of tests of the railway company, together with a copy of the chemical analysis of each heat, showing the tire numbers rolled from each heat; also destination of each tire, together with the railway company's purchasing agent's order number. If, however, the manufacturer is rolling tires right along for the railroad company, and their inspector is at their plant, the test specimens from heats ready at that time may be pulled at the manufacturer's plant by the inspector and the broken test pieces sent in for analysis, in which case the above information must be furnished the inspector.

An analysis of the test piece made by the railroad company's test bureau must agree with that furnished by the manufacturer, and with an analysis made from turnings from the tires after received; a failure to agree within reasonable limits will be cause for rejection.

In addition to the above tests, the railroad company reserves

the right to make a repetition of any tests to make sure that only material meeting all the requirements set forth in this specification be accepted, and all material found not up to any one or all of these requirements will be rejected.

Samples representing rejected material will be retained in the test bureau not longer than thirty days from date of test. If at the end of that period the sellers have not signified their desire for a rehearing, it will be understood that they agree with the results as reported. If by this time the sellers have not given shipping directions for material rejected at destination, the material represented by the samples will be returned to them at their risk, they paying freight both ways.

Secretary Taylor moved that the report be received and that final action be deferred until next year. Carried.

WEDNESDAY, JUNE 19.

At the opening of the meeting a letter from J. F. Walsh was read, asking to place W. T. Smith, formerly of the Chesapeake & Ohio, on the honorary membership list. This was done.

FLANGE LUBRICATION.

The committee reporting last year on the subject of flange lubrication was continued to make still further report to the 1912 convention and the original committee has been increased from three to five members.

In preparing the former report an effort was made to determine to what extent the railways were troubled with flange wear; to describe the methods and devices for applying lubricant to flanges; and to record the effectiveness of lubrication in overcoming flange wear. Having presented its conclusions as based on information available at the time the former report was closed, the committee feels that its further duty lies in recording the development in flang lubrication during the past year; the increase or decrease in the application of flange lubrication; as well as in reporting the further actual experience of the various railways, thereby confirming or refuting its previous report.

Some of the railways which have already made service trials have satisfied themselves as to the effectiveness of flange lubrication. They do not feel justified in going to the expense of still further tests to provide data for additional information. Having determined that lubrication is reducing flange wear and proving economical, they are proceeding with the application of flange lubricators and consider the experimental stage to have been passed.

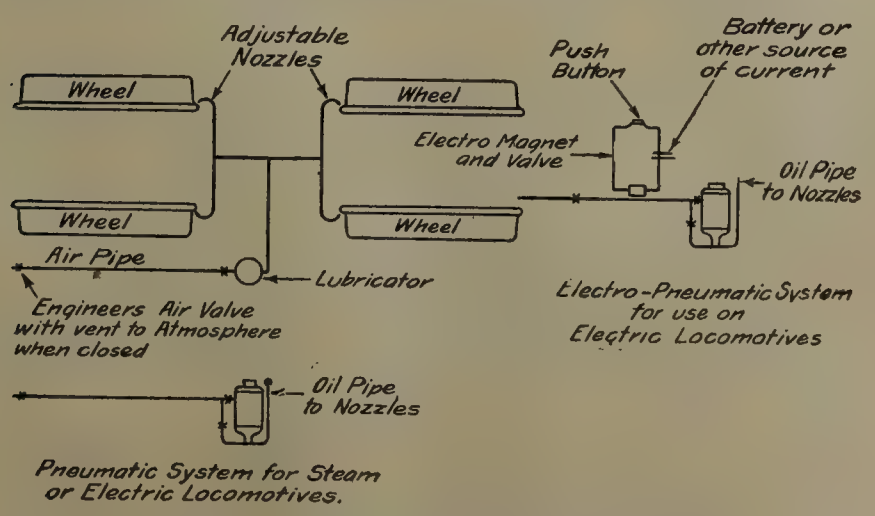
As but little further information seemed available from formal tests, a consensus of opinion was sought through replies to a set of questions distributed to all members, through the secretary of the association. The report is, therefore, a compilation based on the experience of various railroads, and does not represent merely the opinion of a single committee or single individual.

Since closing the 1911 report advice has been received of flange lubricators having been applied by over thirty railroads on which lubricators had not been used previously. In most cases reported, the number of locomotives equipped on each road has been small. In one instance, however, a road operating over 1,100 locomotives has applied flange lubricators to the entire number.

On a number of other railroads, on which flange lubricators were used at the time of preparing the last report, the application has since been extended. The reports of thirty-five of these roads show an average increase of thirty lubricators each, the number per road varying from one to over two hundred.

An affirmative answer to the question, "Does your experience confirm the report on flange lubrication presented at the last convention?" was received from twenty-three of the twenty-nine roads replying in detail to the committee's circular. Five of these roads explained that failure to answer was due to lack of sufficient experience.

Among these railroads on which lubricators have been used, no cases have been reported where flange lubrication has been abandoned. A number of roads have removed certain types of lubricators applied experimentally and replaced them by others. The types of lubricators applied during the past year indicate the most general adoption of crude oil as a lubricant. Some reports state that hard grease has been rejected as unsatisfactory due to the fact that the grease catches and holds sand. The abrasive action resulting has increased instead of decreased the flange wear.



Flange Lubricator for Electric Locomotives.

TABLE I.

MILEAGE SERVICE OF FRONT TIRES REMOVED FROM PACIFIC TYPE ENGINES TO FEBRUARY 1, 1912.

NORFOLK & WESTERN RY.

After Equipped with Oilers. Mileage.			Before Equipped with Oilers. Mileage.		
Eng.	Right Side.	Left Side.	Eng.	Right Side.	Left Side.
564	63,141	63,141	564	26,702	26,702
Average miles per tire, 63,141			Average miles per tire, 26,702		
Tires removed, 2.			Tires removed, 2.		
569	27,889	27,889	569	13,175	13,175
569	39,582	39,582	Average miles per tire, 13,175.		
Average miles per tire, 33,735.			Tires removed, 2.		
Tires removed, 4.			571	17,204	17,204
571	26,728		571	6,845	6,845
571		43,512*	571	12,096	12,096
Average miles per tire, 35,120.			571	16,784	
Tires removed, 2.			Average miles per tire, 12,725.		
572	No tire renewals since oilers applied.		Tires removed, 7.		
573	33,816	33,816	572	15,846	15,846
			572	24,553	24,553
			572	24,297	24,297
			572	14,640	14,640
			Average miles per tire, 19,834.		
			Tires removed, 8.		
Average miles per tire, 33,816.			573	17,972	17,972
Tires removed, 2.			573	15,618	15,618
			573	9,139	9,139
			Average miles per tire, 14,243.		
			Tires removed, 6.		
			Average miles per tire, all engines, 16,518.		

Average miles per tire, all engines, 39,909.

*Includes four months mileage before oiler was applied.

Graphite as a flange lubricant has been reported as successful by some roads, but others have abandoned it for crude oil. Crude oil with a heavy asphaltum base is spoken of with the greatest favor by roads using flange lubricators. It has been successfully applied by both hydrostatic and gravity-feed devices.

Exhaust steam from air pumps as well as water jets are still being used to a limited extent by some railways and beneficial results are reported. An undesirable feature of the water jet is the fact that it must be abandoned during the winter weather.

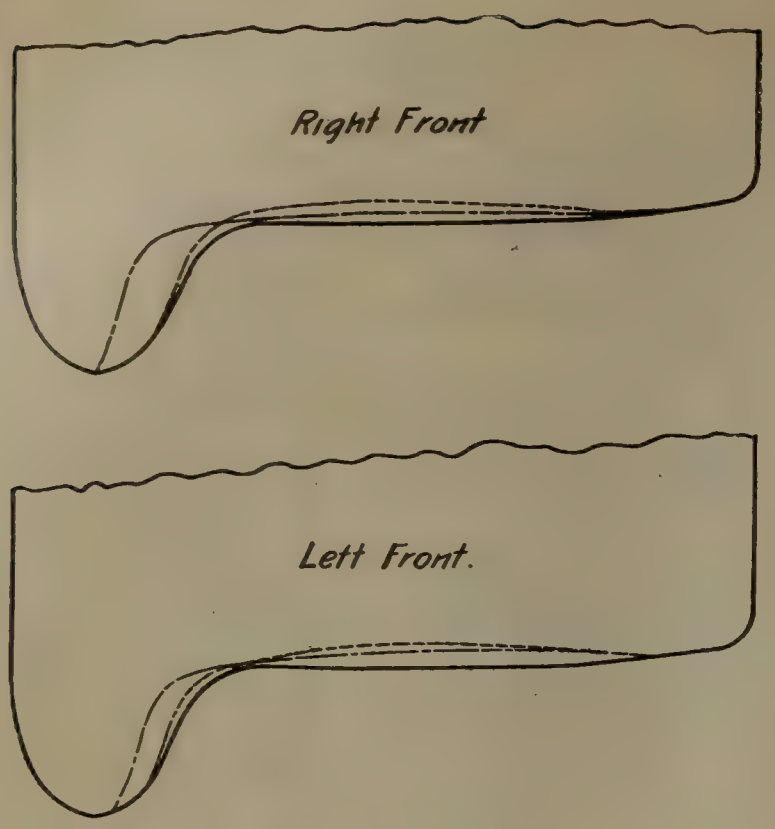
A type of lubricator especially adapted to electric locomotive service has been developed on the Grand Trunk Railway by Mr. W. D. Hall, superintendent of power plant and electrical equipment. This lubricator has been designed to meet the requirements of service through the St. Clair tunnel.

Herewith is a sketch illustrating the principle by which this lubricator is connected and operated. Oil is contained in an air-tight receptacle of one-quart capacity. The oil is led to the wheel flanges by pipes and is sprayed upon the flanges by jets of air. The air is supplied from the main reservoir by a ¼-inch pipe connected to the oil receptacle above the surface of the oil. This provides a pressure to force the oil from the receptacle. A branch of this pipe is connected to the oil delivery pipe leading to the flanges. The oil is thus forced through the pipes and sprayed upon the flanges.

Used with electrical equipment, the air is controlled by an electric push-button. Valves admitting air above the surface of the oil, as well as to the delivery pipes, are operated by electromagnets. The push-button is located in easy access of the engineer and oil is sprayed upon the wheel flanges almost immediately upon the admission of air pressure. With this arrangement flange lubricant is applied only when needed and when running on straight track the lubricator is not continued in operation.

This apparatus has been in successful operation since July 10, 1910, and has operated under extremely severe conditions. Six electric locomotives have been equipped and handle 1,000-ton trains up and down two per cent grades. Owing to the many curves encountered and also because of the rather low center of gravity of the locomotives, flange wear has been quite heavy. Since applying this lubricator the conditions have been improved to such an extent that 50,000 miles and over are made between turnings and it is seldom necessary to remove wheels for tire turning before the armature is removed for commutator dressing, and these two operations may, therefore, be performed at the same time.

Before the application of the lubricator, mileage made between tire turnings was from 12,000 to 25,000. The lubricant used is engine oil, most of which is taken from bearing cellars of the railway armatures when the oil in them is being changed. The oil is filtered before being applied to the flange lubricators. No difficulty has been experienced with the delivery of this oil in cold weather. It is sometimes thinned to suit the weather conditions by the addition of a little coal oil. Care has been exercised in keeping the oil free from anything that might obstruct the nozzle and very satisfactory results have been obtained under varying and severe weather conditions.



Full lines, standard tread and flange as received new from builders. Sept 1909 also represents new tires applied July 28-1910, at which date the Chicago Flange Oiler was applied.

Dotted line____tread and flange July 28-1910 after making 31529 miles (previous to applying flange oiler)

Dotted line____tread and flange March 9-1911 after making 21102 miles (Engine equipped with Chicago Flange Oiler).

Contours taken from Plaster Paris casts.

Flange Lubrication.

The Collins flange lubricator illustrated and described in the former report has since been improved. The improved device is similar in construction to that already described. The feeding device of the original type was placed under the body of the lubricator. The lubricating block of graphite composition was pressed against the flange by a pawl engaging in notches in the under side of the block. With the improved type a coil spring and plunger acting directly behind the block of lubricant presses it against the flange, the feed being continuous without adjustment until refilling is necessary. The 1911 report has given the impression that this lubricator was designed to use hard grease. It should be stated that the lubricant is graphite.

Among the simple devices operated by some of the railway companies is one which can be built up of pipe fittings and has been used to apply either hard grease or graphite. The device consists of a short section of 1¼-inch pipe capped at one end and containing a piston actuated by a spiral spring. A small rod threaded into the piston extends through the cap, not only assisting to guide the piston but also indicating the amount of grease in the lubricator. This device is clamped to the frame of the locomotive in front of the drivers and feeds the lubricant directly against the flange. When using ordinary rod grease the lubricant is contained in a section of scrap rubber hose and is deposited as the hose is worn away.

The Pittsburgh & Lake Erie Railroad has applied this lubricator extensively, using a mixture of paraffin and graphite as the lubricant. This is contained in a wooden block turned up in a lathe, the cavity for the grease being bored out 1 inch in diameter.

The practice of the Pittsburgh & Lake Erie R. R. has been to apply a lubricator to each wheel which has shown wear or cutting. After the flange has been worn smooth it has not been considered necessary to operate the lubricator until further signs of cutting develop.

Some difficulty has been reported as to keeping this device in proper adjustment at all times.

The result of a test of flange lubrication on a number of twelve-wheel locomotives of the Norfolk & Western Railway is contained in the 1911 report. This test led to the conclusion that with track conditions as existing on this line, flange wear was too light on freight engines to warrant the practice of lubrication. Five Pacific type passenger engines have since been equipped with lubricators for test purposes. The equipment includes three types of lubricators —hydrostatic, gravity and graphite. The comparative mileage between tire removals before and after the application of the lubricators is shown in Table I. It will be seen that the average service per front tire removed from these engines before the lubricators were applied was 16,518 miles, while the average for the same engines since the lubricators were installed has been 39,909. The former figures are taken from the record of twenty-five tires removed, the latter from the record of ten tires removed. The local authorities providing the data suggest this result may have been affected in some measure by a lateral spring arrangement applied to the trailer trucks to prevent nosing. They state, however, that they consider the improved condition to be due to lubrication and not to the spring.

Another drawing shows the contour and mileage records of a decapod locomotive on the Buffalo, Rochester & Pittsburgh Railway. Previous to the application of the lubricator this engine had made 31,529 miles with the flanges worn as shown by the dot and dash contour line. After making 21,102 miles with a hydrostatic oiler in service the condition of tires was as shown by the dotted contour lines.

The Hocking Valley Railway Company reports that the service of switch engines operating upon industrial tracks with much sharp curvature has been increased from four months to twelve months. On consolidation engines subject to excessive wear of front and back flanges the service of tires has been increased from one year to two years. At the end of this period the flanges are still in good condition.

The question of saving in rail renewals and decreased train resistance to be realized from lubrication of rails on curves has been carefully investigated by the Pennsylvania Lines west of Pittsburgh. Tests to determine the reduction in rail wear to be obtained by lubrication were made on curves 3 deg. 20 min. and 10 deg. respectively. The rails on the first half of the curve to be traversed were not lubricated and those on the last half were lubricated by hand. We quote the following from the conclusions of the Pennsylvania Committee: "The data collected shows that with lubrication there would be considerable saving in rail and flange wear on roads with sharp curvative. . . . Our tests confirm a saving but show that for light curvature the saving is very little. The tests show very little more wear on curves up to 4 deg. than on straight line."

Records of rail renewal on the Southern Pacific in the Sierra Nevada mountains, where all of the locomotives are equipped with flange oilers, show that since the oilers have been in service the average life of the outside rail on all curves above 5 deg. has been increased from twelve months to thirty-two months, or two and two-thirds times the life prior to the use of flange oilers. The average life of the inside rail on curves above 5 deg. has been increased from thirteen months to thirty-three months, or two and one-half times the life prior to the use of the oilers.

In this connection it should be stated that rails are now removed having a much smaller percentage of wear than those removed a number of years ago. In other words, rails which are now considered unsafe for traffic, a number of years ago would have been allowed to remain in the track several months longer. Keeping this in mind the above figures, which have been abstracted from curve-worn rail reports, will be seen to be conservative.

Attention should also be called to the increase in average daily tonnage. The flange oilers have been in general use on the territory under consideration since May, 1908. For a period of three years prior to that date, the average daily tonnage passing over these curves was approximately 15,000 tons. For the three years since that date the average daily tonnage has been 22,000 tons, an increase of 47 per cent. The increase in tonnage should increase the rail wear, and in order to get at the actual increase in the life of the rail since flange oilers were put into use, this factor should be taken into consideration. Had the average daily tonnage remained 15,000 tons instead of increasing to 22,000 tons, the rail would have lasted 47 per cent longer than it did, or practically a period of forty-eight months. This is nearly four times as long as the life of the rail prior to the use of flange oilers, considering conditions to have been the same in both cases.

Any agency whereby the wear of rail and flanges is reduced may be expected to affect train resistance on curves. This has been observed in the ease with which lubricated engines round curves, but it has not been of sufficient effect to lead to any increase of tonnage rating. It must be considered that the effect of lubricant applied to the flanges of the locomotive drivers decreases very rapidly with increased distance from the locomotive.

The committee of the Pennsylvania Lines, already referred to, continued its tests to determine the effect of flange lubrication on train resistance. A series of runs was made on a division with a grade north-bound of 90 feet per mile and 60 feet per mile south-bound.

About two-thirds of the track over the summit is made up of curves from 2 degrees to 6 degrees 45 minutes. The trains were hauled by a consolidation locomotive. The drawbar pull of runs made with oil lubrication applied to two pair of drivers and the truck wheels, and the runs with graphite applied to the gauge side of the rail by brushes was compared with the drawbar pull without lubrication.

North-bound the trains consisted of the dynamometer car and twenty-nine empty cars weighing about 605 tons. South-bound the trains consisted of the dynamometer car and thirteen loaded cars weighing from 915 to 951 tons.

The tests showed a reduction in drawbar pull with a loaded train of 951 tons, of 285 pounds, or about one-sixth of the drawbar pull for one loaded car. The reduction for empty cars was equal to about one and one-half cars. The tests were not considered conclusive, however, on account of variable weather.

A similar set of test runs was made over another piece of track as nearly level as could be found with curves from 2° 49′ to 9° 59′. This was selected in order to eliminate, as far as possible, any resistance due to grade. The tests showed fairly uniform results and

that there was slight decrease in curve resistance due to lubrication, but not sufficient to allow of another car being added to the train.

It is the practice of many roads, where curves occur on grades, to compensate for the curvature by reducing the grade. Where this practice is followed no decrease in curve resistance can affect tonnage rating.

The flange lubricator, like other devices, requires attention. Any defects or any imperfections in the device or its connections should be included by the engineer in his work report at the end of his trip. This work should be done by the roundhouse force and the roundhouse should be held responsible for repairs.

Engine crews should be held responsible for the performance of the lubricators and where repairs are maintained by the roundhouse, the lubricators require comparatively little attention. In view of the economy in life of tires when flanges are properly lubricated, road foremen of engines should see that lubricators are kept in operation on the engines under their jurisdiction.

With oil as a lubricant the delivery nozzle should be properly adjusted and maintained to direct the oil against the flange of the wheel. If the oil is not deposited on the flange it results in no benefit as a lubricant. If directed toward the tread it will run down to the rail when the engine is standing, and where the nozzle is forward of the wheel, this is apt to cause slipping when starting.

To avoid this, as well as to get away from the sand pipe, the delivery nozzle is often placed at the rear of the wheel. With the hydrostatic lubricator there is a certain objection to this location. On an engine equipped with the Stephenson link motion, the space just back of the first pair of wheels is often the opening through which the engineer reaches in oiling around. With the delivery nozzle located back of the first wheel there is sometimes sufficient steam in cold or wet weather to cause annoyance.

When placed forward of the wheel a good location is just opposite to the top frame rail. This should be far enough from the delivery end of the sand pipe to prevent water of condensation from collecting at the end of the pipe and freezing.

In severely cold weather care should be exercised to prevent water of condensation from freezing in the delivery pipes of the hydrostatic lubricator. By keeping a sufficient flow of steam through the pipes this should be avoided. This steam can be throttled sufficiently to keep the pipes clear without emitting so much steam as to be annoying.

Conclusions.

Considering the previous report and the information upon which the present report has been based, your committee feels justified in the following conclusions:

1. The value of flange lubrication depends upon local conditions.
2. Flange lubrication has proven effective as a means of reducing flange wear, particularly on driving wheels.
3. The effect of lubricant applied to driving-wheel flanges decreases rapidly as distance from locomotive increases.
4. Flange lubrication results in considerable saving in rail wear when sharp curves are frequent.
5. The effect of flange lubrication upon train resistance is not sufficient to make it a factor in tonnage rating.

(Signed) M. H. Haig,
T. W. Heintzleman,
D. J. Redding,
A. Kearney,
W. C. Hayes.

Discussion.

M. H. Haig: The committee reported last year and covered the situation at that time. Since then there has been some developments on electric locomotives, two lubricators for this work being described in the report. Kern River oil is the most satisfactory as it adheres to the flange and rail, forming a paste. On Western oil burners, oil from the fuel tanks is used for lubricating.

One member says that on examining the ball of the rail he could see a slight indication of oil after the train had passed. Another member said that the flange lubricator prolonged the life of the rail one-third. Another stated that while engines in mountain service required tire change every 10,000 miles without the lubricator, a Mikado freight engine made 37,186 miles when equipped with it. A member stated that since using a flange lubricator a ten wheel engine in passenger service had made between 65,000 and 85,000 miles. Before closing this report we received word from a member that he was using a gravity feed Detroit lubricator for flange lubrication.

F. F. Gaines: We have tried all forms of lubricators except the Detroit gravity feed and have decided that this hydrostatic lubricator is the most satisfactory. We had trouble with some Pacific's cutting their flanges after running 30,000 miles, but after equipping them with lubricators, we got 60,000 miles out of them. We save over $500 between tire turnings. One division is completely equipped and the saving amounts to about $50 per year per engine. Tire loss on eight tires equipped with the lubricator was $74.88, as compared with $130.48 when not equipped.

H. C. Van Buskirk: The hydrostatic lubricator is the only one that gives us satisfactory results. The question has been asked if it has any effect on a train descending a grade, and I will say it has not. I have found that the solid lubricants picks up foreign matter. Our engines will run 50,000 miles with the hydrostatic lubricator. We have found that the gravity lubricator will freeze up.

R. D. Smith: Last year's report prompted us to use some flange lubricators on our Pacific type engines and we have had good results. We are extending their use.

S. L. Bean: We have 2,500 miles of road, the longest tangent of which is 30 miles. We have adopted the flange lubricator on 400 locomotives and have increased our mileage in one district from 60,000 miles to over 100,000 miles in passenger service. We credit this to flange lubrication.

L. R. Pomeroy: While with the Rapid Transit Co., in 1886, I arranged a lubricator composed of a piece of ¾-in. pipe, 6 inches long in the end of which was a felt swab. The pipe was half filled with oakum and a spring kept a pressure on the oakum. This was afterwards placed on all the engines of the system.

F. W. Brazier: I am surprised that a device that saves money and has no report against it, is not used more.

M. H. Haig: If the lubricant is properly delivered it should not affect the tractive effort. I do not think there is any difficulty with trains descending grades.

F. F. Gaines: For Mr. Brazier's benefit I wish to say that if he will look in last year's report of the Southern Pacific, it will show considerable saving on tender wheels.

MINIMUM REQUIREMENTS FOR LOCOMOTIVE HEADLIGHTS.

D. F. Crawford: As chairman of this committee I would say that we have no further data than was presented last year. I think it would be interesting to hear from Mr. Rae, of the Louisville & Nashville.

C. H. Rae: During the past 6 months high power headlight bills have been introduced in Kentucky, Mississippi and Louisiana. The railways did not present their views in Mississippi and it was adopted. In Kentucky and Louisiana they did present their case and the bills were rejected. My experiments, verified by the reports of the Interstate Commerce Commission, show that high power headlights are undesirable on railroads having multiple tracks and block signals. High power headlight bills will be introduced in a number of states and I hope that this association will go on record as confirming my views.

F. F. Gaines: I endorse what Mr. Rae has said and I move that we go on record as being opposed to high power headlights on roads having multiple tracks and block signals.

This motion was carried.

STANDARDIZATION OF TINWARE.

The committee appointed to report on the standardization of tinware, and confer with a similar committee from the railway storekeepers, has been unable to collect and compile the data in form to present at this convention.

The Railway Storekeepers' committee held meetings in Chicago, December 19, 1911, and March 20, 1912, to which we were invited; unforeseen and unavoidable business engagements prevented Messrs. Poole and Franey attending. Mr. J. C. Mengel attended the meeting of March 20.

On May 9, the secretary, Mr. Taylor, advised the remaining members of this committee that Mr. A. J. Poole had resigned as chairman, and asked us to meet with the Railway Storekeepers' committee at Buffalo, previous to their convention and present a report. This meeting was held May 19.

Mr. J. R. Mulroy and his committee have prepared a very creditable report. Data which they have gathered from various roads show lack of uniformity in material used, method of construction and dimensions. Some of these affect first cost, others the life of the article. Cans nominally one, two or three gallons capacity have different dimensions and methods of construction on different roads. Some roads dispense with articles which are considered necessary on others.

From the data now collected and with further conference, the committee should be able to recommend standard articles to be used, also standard dimensions, method of construction, and material which will represent good practice on our railways and standard practice of manufacturing.

We recommend the subject be continued for another year.

(Signed) M. D. Franey,
J. C. Mengel.

Mr. Taylor moved that the report be accepted and the committee be continued for another year.

MAINTENANCE OF SUPERHEATER LOCOMOTIVES.

The committee on the maintenance of superheater locomotives was instructed to consider and report on:

(a) The best metal for cylinder and steam chest bushings;
(b) The best metal for valve and piston rings;
(c) The best means of lubricating superheater locomotives.

In order to obtain as much data as possible upon which to base its report, the committee issued, through the office of the secretary of the association, a circular of inquiry to the members, with the following results:

The total number of superheater locomotives in service on the railroads answering the circular of inquiry is 2,222, of which 1,748 are of the fire-tube type and 474 of the smoke-box type. So far as the committee is able to ascertain, there are about 2,500 superheater locomotives of the fire-tube type now operating in the United States and Canada, so that the replies represent 70 per cent of the total number of locomotives now in service, using highly superheated steam.

The following types of superheaters are in use on the railroads replying to the circular: Schmidt, Cole, Emerson, Vaughan-Horsey, Baldwin, Jacobs and Vauclain.

The results are not based on any particular type of locomotives, as many different classes or types were reported as having superheaters, among which are Pacific, Consolidations, Mallets, Prairie, Mikado, Mountain and 10-wheelers.

Superheater locomotives have been operating on American railroads for eleven years, but most of the thirty-six roads referred to have been operating them for at least one year.

As might be expected, the steam pressures and degrees of superheat vary considerably on the various types of locomotives on different roads, the maximum steam pressure being 220 pounds per square inch, and the minimum 150 pounds per square inch. The degrees of superheat, that is, the excess in temperature of superheated steam over the temperature of saturated steam at same pressure, varies from 100° to 250° F. for fire-tube superheaters and from 10° to 65° F. for smoke-box superheaters. The temperature of superheated steam as used in locomotives rarely exceeds 600° F.

Twelve roads reported that cylinder and steam-chest bushings on superheater locomotives wear out more rapidly than on locomotives of the same classes using saturated steam, and twenty roads replied that there is no perceptible difference in the wear of cylinder and steam-chest bushings between locomotives using superheated steam, as now operated, and those using saturated steam. All roads reporting more rapid wear on superheated steam than on saturated steam locomotives have superheaters of the fire-tube type, giving a high degree of superheat, but all roads having superheaters of this type do not report more rapid wear of bushings.

Fourteen railroads report that valve-packing rings of superheater locomotives wear out more rapidly than those of saturated steam locomotives of the same classes, and seventeen roads state there is no appreciable difference between the wear of the rings on superheater locomotives as now operated and those of saturated steam locomotives.

Sixteen roads report they have found Hunt-Spiller gun iron the best metal for cylinder and steam-chest bushings, and one other road intends to use this iron for cylinder and steam-chest bushings of new locomotives. Nine roads state they are using gray iron for bushings, three roads use the same metal for the bushings of superheater locomotives as is used for saturated-steam locomotives, and one road is undecided as to the best metal.

All the roads favoring the use of Hunt-Spiller gun iron for bushings also favor its use for piston and valve packing rings, and two other roads report using this material for rings but do not use it for bushings.

The ordinary "L" type of spring packing ring is used for valve packing on practically all the railroads, and most of them use the ordinary rectangular section rings for piston packing.

The use of extensions is so closely allied to the consideration of the wear of cylinder and steam-chest bushings, it was thought advisable to include this question in the circular of inquiry. Replies also placed us in position to better understand conditions under which superheater locomotives are operating. Eighteen roads use piston-rod extensions and twelve use valve-stem extensions, but three of the eighteen roads using piston-rod extensions are eliminating them.

Eight roads favor the use of piston-rod extensions, nine favor the use of valve-stem extensions, and six advocate the use of piston-rod extensions on locomotives having large and heavy pistons.

Eleven roads are opposed to the use of either piston-rod or valve-stem extensions and two are undecided as to their desirability.

Twenty-three roads report there is no unusual difficulty in properly lubricating the cylinders and steam chests of superheater locomotives as they are now operating. Five roads report it is difficult to properly lubricate superheater locomotives and three state that trouble was experienced at first, but the use of a different grade of oil has overcome the trouble. One road using balance slide valve states it is difficult to properly lubricate the valve, but no difficulty is encountered in lubricating the cylinders. Reports indicate it is no more difficult to lubricate locomotives with smoke-box superheaters than to lubricate the ordinary saturated steam locomotive.

Twenty-nine roads answering this question are using hydrostatic feed lubricators with entirely satisfactory results. There is but one road using mechanical feed lubricator exclusively. Of the roads now using hydrostatic lubricators, four had formerly tried mechanical feed lubricators. The advantages of the hydrostatic lubricator are its reliability, simplicity of construction and ease of regulation as compared with the considerable number of moving parts of mechanical feed lubricators and the tendency of the latter to wear and get out of order.

Atomizers are used on three roads and results reported as satisfactory, but we are of the opinion that without atomizers, when the oil is discharged into the steam passageway above the entrance to the steam chest it is partially atomized, which would seem to be desirable.

There are a number of different arrangements of oil pipes on superheater locomotives and these may be divided as follows:

(a) The most common arrangement is that in which the oil is delivered at the center of steam chest and at the center of cylinder.

(b) Another arrangement is that in which the oil is discharged into the steam passageway above the entrance to the steam chest, with an independent connection to the center of the cylinder.

(c) Some roads use oil connections to both ends of the steam chest, with an independent connection to the center of the cylinder.

(d) A common arrangement, and one that is growing in favor, has a connection which discharges oil into the steam passageway only. It is claimed that the oil is thoroughly mingled with and distributed by the steam.

(e) A few roads report having oil connections to the center of the steam chests only.

Twenty roads consider it necessary to lubricate the cylinders of superheater locomotives independent of the steam chest, eight roads that it is unnecessary and two are undecided.

From replies received and from the experience of members of your committee, there seems to be no doubt that an oil connection into steam passageway only, near entrance to steam chest, is the best arrangement for obtaining satisfactory lubrication. It reduces the number of feeds to a minimum and furnishes sufficient oil to valves and cylinders.

The allowance of valve oil per 100 miles for superheater locomotives varies according to type and service. The maximum allowance reported for Pacific type locomotives with fire-tube superheaters is 3.25 pints per 100 miles and the minimum 1.25 pints, the average allowance being 2.25 pints.

For consolidation locomotives with fire-tube superheaters, the allowance of oil varies from 2.50 pints to 1.25 pints, the average being 1.75 pints per 100 miles.

The average allowance of oil for Mikado locomotives with fire-tube superheaters is 4 pints and the allowance for Mallets is about 6 pints per 100 miles.

Answers to this question indicate that the allowance of valve oil for superheated steam locomotives varies in about the same proportion as for saturated steam locomotives, according to type and service. It is customary to allow about 45 per cent more oil for the fire-tube superheater than for saturated steam locomotives, while locomotives with smoke-box superheaters usually have the same allowance of oil as saturated steam locomotives.

Twelve roads report using special superheater oil exclusively on superheater locomotives and thirteen roads report using the ordinary grade of valve oil, but all the roads using superheater oil report it is more satisfactory, and tests which have been made of the two kinds of oil, on superheater locoomtives, bear out this statement.

None of the roads report the admission of steam automatically to the cylinders when drifting, but twelve roads report good results from keeping the throttle slightly open when engine is drifting, and this practice seems to meet with most general approval.

Answers to this question show that the use of vacuum valves on superheater locomotives is quite general on American roads, as twenty-three roads report their use gives satisfactory results and five roads report using by-pass valves.

There are a number of different makes of metallic piston-rod packing in use on superheater locomotives, all reported as giving satisfactory service. In general, the same type are used as on saturated steam locomotives, the principal difference, if any, being in the composition of the rings.

The chemical composition of the packing rings is in most cases unknown to the railroads, the rings being purchased in finished state from the manufacturers. Where reports are given, a mixture of 80 per cent lead and 20 per cent antimony has been used with several makes of packing. Some roads have tried a mixture containing a small percentage of tin, but this has been found unsatisfactory. A widely different mixture containing approximately one-half copper and one-half lead has given exceedingly good results, but is expensive. In general, the preferable composition for packing rings is still largely a matter of experiment.

The committee received a great many suggestions and much information that is embodied in the report. The replies were so general as to indicate that this is a very live subject, and the committee feels that a report based on replies from such a large number of railroads may be considered as representing conditions prevailing on practically all the railroads in the country.

Summary.

An analysis of the replies indicates that the results obtained from superheater locomotives have been very satisfactory.

It is interesting to note that five years ago there were less than a dozen superheater locomotives operating in the United States, whereas at the present time there are about 2,500 locomotives in the United States and Canada having fire-tube superheaters.

Minor difficulties have been experienced on a number of railroads; but the great advantages to be derived from the use of superheated steam, such as increased economy of coal and water, increased power, due to the absence of cylinder condensation, the permissible reduction of steam pressure combined with the use of larger cylinders—all obtained without material increase in the size or weight of boiler—leads us to believe that the use of superheated steam in locomotives will increase rapidly.

This being so, it is of great importance to determine the metal best suited for use for bushings and packing rings on modern superheater locomotives, because the use of highly superheated steam increases the difficulty of obtaining proper lubrication, and thus the metal is subjected to more severe working conditions than are usually found with saturated steam locomotives.

It is also important that we know the best means of securing proper lubrication because the efficiency of lubrication has a direct bearing on the life of bushings and packing rings.

A metal suitable for use as cylinder and steam-chest bushings of superheater locomotives should be homogeneous, close grained, tough and of good wearing quality, combined with sufficient strength. It should be tough in order to resist wear, but at the same time it must be of such composition that it can be readily machined.

Replies to the circular of inquiry indicate that Hunt-Spiller gun iron has been used on many railroads with excellent results. This is stated to be an air-furnace charcoal iron, and the process of manufacture, combined with proper chemical composition, seems to result in a metal which is well adapted for use with highly-superheated steam. The analysis of this iron, obtained by your committee, is as follows:

Silicon	1.40 per cent
Phosphorus	0.35 per cent
Sulphur	0.07 per cent
Manganese	0.49 per cent
Combined carbon	0.80 per cent
Graphite carbon	2.20 per cent

Replies indicate that this same iron has been used extensively for piston and valve packing rings on superheater locomotives with

very satisfactory results and that an iron of this character is the best metal so far produced for piston and valve packing rings of superheater locomotives.

The importance of properly lubricating cylinders and steam chests of superheater locomotives, especially those using a high degree of superheat, can hardly be overestimated, because if proper lubrication is not obtained, many of the advantages derived from the use of superheated steam are offset by continual troubles from excessive cutting of bushings and packing rings, which keep the engine in the engine house when its proper place is on the road.

There seems to be a tendency to use too much oil in superheater locomotives, with the result that there is trouble from the oil carbonizing on the cylinder heads, pistons and steam passages. The deposit of carbon also tends to diminish the life of the metallic piston-rod packing, as it builds up in the stuffing boxes and under the vibrating cups to such an extent that the packing in a short time is forced to carry a part of the weight of the piston rod and piston head.

On certain classes of locomotives, possibly those having pistons exceeding 24-inch diameter, it is considered by some advisable to lubricate the cylinder independent of the steam chest, but in most cases we believe better results will be obtained by eliminating the connection to the cylinders and delivering the oil to the steam passageway.

We do not approve of the arrangement of oil pipes in which the oil is delivered near the end of the steam chest, as in this case it is probable that part of the oil is lost in the exhaust, due to the difference in pressure between the live and exhaust steam.

A number of roads report that when superheater locomotives were received from the builders oil was delivered to both ends of the steam chest and to the center of the top of the cylinder; but this arrangement has since been changed so that the oil is now delivered into the steam passageway above the entrance to the steam chest, and the feed to the cylinder has been discontinued. The allowance of oil has also been reduced and it has been found that the locomotives are much better lubricated than formerly and there is a marked diminution in the quantity of oil adhering to the cylinder heads, piston heads and steam passages.

There can be no doubt of the advisability of using a good grade of mineral oil having a high flash point, for locomotives using highly superheated steam, because the temperature of the superheated steam is sometimes as high as 600° F. A number of the roads state they have used valve oil having a flash point of about 520° and also special superheater oil having a flash point of at least 585°, and in every case better results have been obtained from the oil having the higher flash point.

Tests have shown that a moderately high temperature has very little effect on the lubricating properties of a good grade of valve oil when the oil is protected by steam, but when the engine is drifting there is, in most cases, no steam in the cylinders, and the bushings are apt to become hot.

There does, however, appear to be a difference in the results obtained on superheater and saturated-steam locomotives. When drifting the conditions are the same on both, but on saturated-steam locomotives the oil deposit in the cylinders is fluid and the condition of the oil does not appear to have changed; while on superheater locomotives the deposit is gummy and sticky to the touch. This difference may possibly account to a large degree for the rapid wear of piston rings and bushings occasionally experienced on superheater locomotives.

When an engine is drifting a good deal with a closed throttle, there is a considerable vacuum in the cylinders and steam chests, and cinders may be drawn through the exhaust and dirt through the relief valves.

This dirt may adhere to the gummy oil on the cylinder walls and convert them into a lap which will wear away the packing rings and piston heads very rapidly.

This theory explains the good results obtained on locomotives where the drifting throttle has been carefully used and is supported by analyses of the deposit found on the cylinders, which show the presence of cinders and dirt in considerable quantities.

The remedy is obviously to obtain a quality of oil that does not make a deposit of this nature at the temperature to which it is exposed, and to provide means either by ample vacuum or by-pass valves, or by the admission of steam to prevent over-heating when drifting.

Many roads use a tandem type of metallic packing on account of the importance of preventing the blowing out of the lubricating oil, which might result in the cutting of the cylinder bushings.

During the past year or two, several alloys have been tried that have given satisfactory results, and while the preferable mixture will vary with the type of packing employed, this question is not now a serious one.

It is important to use a type of piston-rod packing which will stand up under the high temperature met with in the use of superheated steam, and considerable trouble has been experienced with packing that had proven satisfactory with saturated steam when this point had not been attended to. The melting point of the packing rings should be higher than the melting point of rings usually found on saturated-steam locomotives.

In conclusion, your committee feels that, in order to insure satisfactory results in the operation of superheater locomotives, it is of the utmost importance not only to use the best metals for parts subjected to the action of superheated steam, but it is also important to take all reasonable precautions to obtain proper lubrication.

When superheater locomotives were first placed in operation it was to be expected that certain difficulties would be experienced, but these difficulties have been overcome one by one and we believe that at the present time, with reasonable care in operation and with proper attention on the part of engine-house forces, superheater locomotives will be no more difficult to maintain than saturated-steam locomotives of the same classes.

(Signed) R. D. Smith,
W. H. Bradley,
H. H. Vaughan,
Joseph Chidley,
J. B. Kilpatrick.

After reading the report, R. D. Smith spoke of the remarkable development of the use of superheaters, stating that in 1909 there were less than 50 superheater locomotives and that now there are over 3,000. He also said that in parting cylinder rings for superheat, an opening of at least ⅛ inch should be left.

Discussion.

C. A. Seley: I regret that the committee did not express itself with regard to piston rod and valve stem extensions. The locating of these often affects the buffer beam. We have removed these on some engines and find little increased wear. I favor the valve stem extension, but have always questioned the value of the piston rod extension.

C. E. Chambers: The committee made no mention whatever whether snap rings or the Dunbar type of packing was used. The Dunbar packing allows for more expansion without cutting the sides of the cylinder.

F. F. Gaines: We have had very favorable results with Hunt-Spiller gun iron—a master mechanic told me that he had almost done away with the cylinder boring bar. A demonstration at a railroad club meeting showed effectively that oil should be applied to the steam pipe and the nozzle extended to the center of the pipe.

C. E. Chambers: We have one superheater engine of the Atlantic type running in fast service. We pipe oil direct into the passageway, about half-way between steam chest and arch. We have had no bad results so far.

J. R. Onderdonk: On tests made on the B. & O. we get better results by lubricating the steam than by introducing the lubricant into the steam chest. Introducing the oil into the steam passage seems to atomize it so that all parts are lubricated.

Thos. Roope: I was interested in Prof. Benjamin's paper of yesterday where it was stated that a saving of fuel of 20 per cent was anticipated. This is remarkable. We now have 200 engines equipped with superheaters and hope that the time will come when we can discontinue every other coaling station.

W. C. Hayes: There is nothing in the report pertaining to superheater operation and I think this is one of the most live questions today. The Erie has 35 Mikados with Schmidt superheaters, in the hilly districts, and in four or five days we had six engines give up their trains. The saving and efficiency of the superheater is more than absorbed in the cost of maintenance. If the superheater locomotive can be kept in operation, it is undoubtedly a great saver.

C. A. Seley: The Rock Island had the greatest number of superheaters in the country for some years. I have frequently been asked how much superheat we get, and would say that I don't know or care very much. The point is to have a practical road proposition. Changes had to be made and it took us two or three years to work the question out. As to the economy, I am unable to say. We have 60 superheater engines, all but one being passenger engines. Mr. Quayle, of the North-Western, told me that their engines were giving 10 per cent greater tonnage rating and they were getting 25 per cent fuel economy.

J. A. Pilcher: I would like to know what was Mr. Hayes' trouble. We have had good reports on our road (N. & W.) so far.

W. C. Hayes: We have had a variety of troubles, principally with leakages in the superheater header and engines not steaming. They are good when they work all right, but we are unable to show any saving.

S. L. Bean: I would like to know if anyone has had any trouble from tubes breaking and piston rod packing blowing out on the road.

E. A. Murray: Last year we took an interest in saving of fuel and on 25 Mallets found we were saving 18 to 26 per cent per 1,000 freight ton miles over the previous year when we used saturated steam. We developed as high a fuel economy as 42 per cent.

J. A. Pitcher: Did you compare a compound Mallet with a consolidation of the same type?

E. A. Murray: Yes.

A. B. Appler: I would like to ask if the flat joint or the ball joint is used on the Erie and did they give trouble?

W. C. Hayes: I can't give any of the details now.

E. A. Murray: We had leaky joints until we renewed them and since we have had no trouble.

C. D. Young: The Pennsylvania has not had long experience with high degree superheat. We have today over 200 engines on order or in service. Have not had much trouble so far, most of it being with the lubrication and the packing rings. We have found it hardly necessary to lubricate the cylinder. We are now making an investigation of the details of operation. The hydrostatic lubricator has not been entirely satisfactory. The superheater locomotive is very sensitive to minor troubles. Recently some experiments were made to determine the temperatures in the packings and bushings. The extension on the piston rod is not necessary but is on the valve stem. I move that the committee be continued and next year be asked to report on the operation and maintenance of the superheater.

E. W. Pratt: We now have 200 superheater locomotives of the consolidation and Pacific types. As fast as the saturated steam engines pass to the shop they are equipped with superheaters. We have had no trouble with joints leaking. We are not using the extended rod and we have had a few cases of melted rod packing. We use cylinder feeds on some engines and on some we do not.

I would like to emphasize the avoidance of drifting with the superheater. I may be able to take this back in a year or two, but I hate to see pressure going up to 200 and 220 pounds, as I don't believe it necessary on all classes of engines. We never disturb the damper unless it freezes up as it did last winter.

M. K. Barnum: We have 125 superheaters, and so far they are free from troubles. We have had no trouble from piston packing. Our packing was developed on the Harriman Lines and has holes in a curve on the face of the ring. It is a snap ring packing. In experimenting with it we found that where new packing had been required every 700 miles, it now ran 5,000 miles. We use a ball joint on the units and have little trouble. We are getting 20 per cent fuel economy and expect to have 200 superheaters by the end of the year.

M. Flanagan: I think it would be beneficial if Mr. Barnum would give us a sketch of that packing for the proceedings.

M. K. Barnum: I would be glad to do so. It is a Paxton-Mitchell packing and very satisfactory.

J. F. DeVoy: In bad water districts, the superheater engine works much better than the saturated steam engine.

J. Chidley: We have removed dampers on the Lake Shore & Michigan Southern.

D. J. Redding: Is it necessary to maintain constant lubrication?

T. R. Cook: We have had but little experience, but the force feed lubricator seems to give constant lubrication. The best location of the lubricating pipe is in the steam pipe.

R. D. Smith: Spring ring packing is most generally used. The suggestion of lower pressure, I think, a most excellent one, providing the clearances are sufficient.

ENGINE TENDER WHEELS.

The secretary stated that a committee of wheel manufacturers took this matter up and the matter was referred to the M. C. B. committee. On account of the lateness of the date, the committee has had no time to make recommendations. It is suggested that their recommendations be given to the Master Mechanics' Association.

F. F. Gaines: I move that the report be received and the recommendation go to letter ballot for standard practice.

This motion was carried.

CONCLUSION.

The officers elected for the coming year are as follows: President, D. F. Crawford (Penna.); first vice-president, T. Rumney (C. R. I. & P.); second vice-president, D. R. MacBain (L. S. & M. S.); third vice-president, F. F. Gaines (C. of G.).

RAILWAY SUPPLY MANUFACTURERS' ASSN.

The Railway Supply Manufacturers' Association held its 1912 annual meeting on the Million Dollar Pier, Atlantic City, N. J., June 15. President B. E. D. Stafford opened the meeting with an address in which he reviewed the work of the year.

Mr. Stafford spoke of the foresight of the association in establishing a permanent secretary's office and told how it had resulted in the accumulation of correspondence, agreements, contracts and other data that is now almost indispensable to planning and carrying out the work of the constantly changing executive administration. He commended the efficient work of the outgoing executive and other committees, and of the vice-president and treasurer, and commented on the change of policy due to the demand of the two railway associations that certain practices heretofore recognized as standard be modified and told of the efforts made by the executive committee to conform to the wishes of the parent organizations in both letter and spirit.

This year the space on the Million Dollar Pier occupied by exhibitors is 83,507 sq. ft., as against 76,830 in 1911. The track exhibits compare favorably with those of a year ago. This year the membership of the association is composed of 270 exhibitors and 225 non-exhibitors, as against 245 of the former and 209 of the latter in 1911. Although more exhibit space was provided this year, something like 100 possible exhibitors could not be accommodated.

Following the president's address, C. S. Storrs introduced a resolution so amending the final paragraphs of Section 7, Article I, of bylaws of the association as to make it read as follows:

"After the executive committee shall have fixed this surplus amount, any money in its hands in excess of same may be returned to the members pro rata upon their payment for dues, badges and exhibit space." The resolution was adopted unanimously.

The object in adding the word "badges" to Section 7, Article I, of the bylaws, was as President Stafford pointed out in his address, to make it possible to include in the rebates to members any of the surplus derived from the sale of extra badges; and thus permit non-exhibiting members to share in that rebate.

On the subject of elections to the executive committee by voting members in the various districts, Scott Blewett spoke strongly in favor of making every effort to arouse greater interest in such elections. His remarks were approved by other speakers.

Elections of members of the executive committee, each member to serve three years, were reported as follows and duly approved: First district, Fred. M. Nellis, Westinghouse Air Brake Co., Boston, Mass.; Second district, Oscar F. Ostby, Commercial Acetylene Co., New York; Fourth district, J. C. Whitridge, Buckeye Steel Castings Co., Columbus, Ohio; Seventh district, S. M. Dolan, American Car & Foundry Co., St. Louis, Mo.

The nominating committee for officers to serve for the ensuing year reported as follows: For president, Samuel G. Allen, vice-president of the Franklin Railway Supply Company, New York, and for vice-president, B. A. Hageman, Jr., president of the U. S. Metal & Manufacturing Company, New York.

The secretary was instructed to cast the unanimous ballot of the meeting for these officers.

A rising vote of thanks was tendered President Stafford for his successful administration.

TRAVELING ENGINEERS.

The twentieth annual convention of the Traveling Engineer's Association will be held at the Sherman Hotel, Chicago, August 27th to 20th, 1912, inclusive. Secretary Thompson advises that the membership of this organization now closely approaches the one thousand mark.

The 1911 convention of this association marked an epoch in its history so great was the interest shown in attendance, both by members and supply men. Doubtless the decision to hold the 1912 meeting in the same place is, at least in part, due to this success.

It is the intention this year to have prominent officers from the operating and mechanical departments address the convention each meeting alternately. It is expected that the program will be of great interest and of as great benefit to those attending. President C. W. Hayes of the Erie has been working hard on this feature.

On the supply side the enthusiastic work of Mr. J. Will Johnson of the Pyle National Electric Headlight Co., last year so productive of results, is again in evidence. Mr. Johnson's long experience in connection with the mechanical conventions makes his assistance of great value. It is expected that the exhibit will even surpass that of last year.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.

The 1912 annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association will be held at the Palmer House, Chicago, August 27, 28 and 29. A committee which will be in charge of entertainment has been appointed as follows. W. S. Schlacks, McCord & Co.; L. S. Wright, National Malleable Castings Co.; Wm. Walsh, Galena Signal Oil Co.; T. H. Goodnow, Armour Car Lines; W. C. Walsh, American Steel Foundries Co.; J. G. Towse, American Brake Shoe & Foundry Co.; Chas. McCuen, Ward Equipment Co.

The constantly growing interest in this association bids fair to be more in evidence than ever at the 1912 convention. The membership has grown considerably and all are much interested in the work of the association.

Exhibitors at the Mechanical Convention

C. A. Schroyer, of the North Western.

G. A. Rees, V. P. and G. M. of the Chicago Pneumatic Tool Co., Looking Things Over at Atlantic City.

J. J. Brooks, of Hubbard & Co.

Walter D. Craft, the Vixen File Man.

Following is a list of the firms represented at the Master Car Builders' and American Railway Master Mechanics' conventions, Atlantic City, N. J., June 12 to 19, 1912:

Acme Machine Company, Cleveland, Ohio. Represented by D. R. Davies.

Acme Supply Company, Chicago, Ill. Represented by H H. Schroyer, T. K. Dunbar and C. R. Jamison.

Acme White Lead & Color Works, Detroit, Mich. Represented by D. E. Robinson, K. J. Bowers, C. F. Elliott, H. D. Gillespie.

Adams & Westlake Company, Chicago, Ill. Represented by C. L. Walters, F. N. Grigg, J. T. Ross, E. L. Langworthy.

Ajax Manufacturing Company, The, Cleveland, O. Represented by John R. Blakeslee, A. L. Guilford, John Bickman and J. A. Murray.

Ajax Metal Company, Philadelphia, Pa. Represented by Wm. J. Coane, G. H. Clamer.

Alcohol Heating & Lighting Company, Chicago, Ill. Represented by Herbert Green and Ralph J. Hinkle.

American Abrasive Metals Co. Represented by J. P. Warfle.

American Arch Company, New York, N. Y. Represented by Le Grand Parish, J. P. Neff, C. A. Coons, M. C. Beymer and John Nicholson.

American Balance Valve Company, The, Jersey Shore, Pa. Represented by J. T. Wilson, Frank Trump and C. C. Young.

American Brake Company, The, St. Louis, Mo. Westinghouse booth. Represented by E. L. Adreon and R. E. Adreon.

American Brake Shoe & Foundry Company, Mahwah, N. J. Represented by F. W. Sargent, W. S. McGowan, N. J. Holden, J. S. Thompson, E. L. Janes, J. V. Hogan, R. M. Brower, H. Rochester, J. R. Haywood, A. H. Elliott, L. R. Dewey, and R. E. Holt.

American Brass Company, The, Coe Brass Company Branch, Ansonia, Conn. Represented by Chas. E. Van Riper, Wm. H. Rippere, R. S. Wildman and Wm. W. Cotter.

American Car & Foundry Company, New York, N. Y. Represented by B. M. Carr, Scott H. Blewett, S. M. Dolan, L. W. Martin, W. G. Pearce, B. Wilson, C. D. Eaton, W. H. Sanford, A. E. Ostrander, T. E. Lyons and E. H. Fisher.

American Infusion Steel Process Company, New York, N. Y. Represented by W. C. Whyte, A. J. Thompson, R. C. Longenecker.

American Locomotive Company, New York, N. Y. Represented by H. F. Ball, A. Haller, C. J. Donahue, W. P. Steele, C. A. Strom, W. E. Woodward, J. H. Wynne and J. E. Dixon.

American Mason Safety Tread Company, Boston, Mass. Represented by Henry C. King and L. H. Myrick.

American Nut & Bolt Fastener Company, Pittsburgh, Pa. Represented by Robert Spencer.

American Pulley Company, Philadelphia, Pa. Represented by Morris W. Rudderow.

American Roll Gold Leaf Company, Providence, R. I. Represented by T. J. Lawler, C. H. Bowers, A. Waldron and C. E. Smith.

American Steel Foundries, Chicago, Ill. Represented by R. P. Lamont, Geo. E. Scott, W. J. Lynch, J. C. Davis, T. D. Kelley, J. V. Bell, G. F. Slaughter, W. Ross Gravener, P. J. Kalman, D. T. Harris, J. W. Dalman, M. R. MacLean, J. R. Stuart, A. S. Crozier, T. H. Hopkirk, W. M. Rogovine, R. E. Janney, Geo. G. Floyd, F. B. Ernst and Louis E. Jones.

American Tool Work Company, Cincinnati, O. Represented by Robert S. Alter, C. K. Cairns, Herman Schatz, W. G. Wallace and Edward Conners.

This Is Joe Taylor.

Beaumont and Sharp, of the Grip Nut Co., Impersonating Jeff and Mutt.

Moran and Lennon, of the Bethlehem Steel Co.

F. F. Gaines, of the Central of Georgia, and Wife.

American Vanadium Company, Pittsburgh, Pa. Represented by R. B. Steele, A. W. Menuse, W. A. Bonitz, D. B. Browne, C. L. Hastings, W. J. Bird, P. A. Bevan and G. L. Norris.

Anchor Packing Company, Philadelphia, Pa. Represented by D. Murray, J. B. Webb and B. J. Miller.

Anglo-American Varnish Company, Newark, N. J. Represented by Wm. Marshall.

Automatic Ventilator Company, New York, N. Y. Represented by R. Taylor, W. H. Robb, George H. Ford and Wm. J. Fleming, Jr.

Baker Brothers, Toledo, O. Represented by Geo. E. Hallenbeck, C. A. Goodspeed and W. W. Elliott.

Baker Car Heater Company, W. C., Detroit, Mich. Represented by D. W. Smith and H. S. Williams.

Baldwin Locomotive Works, Philadelphia, Pa. Represented by W. B. Keys, C. Greenough, A. G. Machesney and A. S. Goble.

Ball Chemical Company, Pittsburg, Pa. Represented by H. G. Taylor, J. J. Toomey, C. O. Taylor.

Barco Brass & Joint Company, Chicago, Ill. Represented by F. N. Bard and E. S. Nelson.

Barney & Smith Car Company, Dayton, Ohio. Represented by R. M. Mitchell, A. J. Stevens, J. F. Kiefaber.

Baush Machine Tool Company, Springfield, Mass. Represented by C. K. Lassiter and F. E. Becorselski.

Berger Manufacturing Company, Canton, Ohio. Represented by M. R. Bissell.

Berry Brothers, Ltd., Detroit, Mich. Represented by J. S. Stevenson, John S. Wilson and Walter E. Page.

Best Manufacturing Company, Pittsburgh, Pa. Represented by George Best.

Best, W. N., New York, N. Y. Represented by W. N. Best.

Bethlehem Steel Company, South Bethlehem, Pa. Represented by W. C. Cutler, Geo. W. Costello, J. M. Price, John Moran, Hugh Lennon and E. P. Hess.

Bettendorf Axle Company, Bettendorf, Ia. Represented by J. W. Bettendorf, M. Bettendorf, J. H. Bendixen, F. K. Shults, J. E. Phillipi, A. F. Macpherson, E. E. Silk, W. G. Ransom, C. G. Stolpe and J. L. Goddard.

Blackall, R. H., Pittsburgh, Pa. Represented by R. H. Blackall.

Bordo, L. J., Company, Philadelphia, Pa. Represented by C. W. Allens.

Boss Nut Company, Chicago, Ill. Represented by J. T. Benedict, J. A. MacLean, D. O. Ward and Ed. Wilhelm.

Bowser & Company, Inc., S. F., Ft. Wayne, Ind. Represented by C. A. Dunkelberg, W. T. Simpson, Edward Barnes and F. T. Hyndman.

Brown Automatic Connector Company, Chattanooga, Tenn. Represented by M. A. Brown and A. L. Kirkpatrick.

Brunix Manufacturing Company, Philadelphia, Pa. Represented by W. B. Howard.

Buckeye Steel Castings Company, The, Columbus, Ohio. Represented by S. P. Bush, J. C. Whitridge, Geo. Groobey, Geo. T. Johnson, W. C. Speck, F. H. Baunet, C. E. Mendenhall and C. B. Goodspeed.

Buffalo Brake Beam Company, New York, N. Y. Represented by S. A. Crone, Edwin Strassburger, Thomas E. Carliss, Roland C. Fraser, O. W. Meissner and C. E. Barrett.

Bullard Machine Tool Company, The, Bridgeport, Conn. Represented by G. W. Conklin, S. H. Bullard, J. W. Bray, R. H. Snider and F. B. Smith.

Butler Drawbar Attachment Company, Cleveland, Ohio. Represented by W. B. Waggoner.

Buyers' Index Company, Chicago, Ill. Represented by N. F. Rehm, H. E. Frame and Alex Smith.

Cambria Steel Company, Johnstown, Pa. Represented by J. Leonard Reflogle, Ralph V. Sage and E. H. Bankard, Jr.

W. J. Tollerton, of the Rock Island, and E. W. Pratt, of the North Western Lines.

B. E. Bushnell, of Stewart H. Hartshorn Co.

Messrs. Arlein, Swallow and Smith, of W. H. Coe Mfg. Co.

C. Phillips, M. M., N. O. & N. E., and Son, Cyral Harvey Phillips.

E. D. Nelson and F. H. Clark, G. S. M. P., B. & O. R. R.

I. H. Case, of the Dearborn Drug & Chemical Works.

J. T. McGrath, S. R. S., Chicago & Alton R. R.

Chas. N. Smith, of the Mamolith Carbon Paint Co.

Stewart H. Hartshorn.

Interior Booth of the Dearborn Drug & Chemical Works—At the Right is the Entrance to the Porch, Shown Below.

Outside Porch of the Dearborn Drug & Chemical Works, Overlooking the Beach and Ocean.

LeGrand Parish, American Arch Co., Geo. L. Bourne, Locomotive Superheater Co., W. H. Coyle, Franklin Railway Supply Co., and J. L. Mohun, Franklin Railway Supply Co. Simon Hoffman of the Locomotive Superheater Co. Is Also Trying to Get a Look-In.

Camel Company, Chicago, Ill. Represented by P. M. Elliott, J. M. Hopkins, W. W. Darrow and J. F. Comer.

Canadian Car & Foundry Company, Montreal, Que. Represented by F. Ditchfield.

Carbon Steel Company, New York, N. Y. Represented by H. N. Fennell.

Carborundum Company, The, Niagara Falls, N. Y. Represented by C. C. Schumaker, W. W. Sanderson, C. C. Lathrop, R. H. Hogg, J. F. Hanlon and R. S. Marvin.

Carey & Company, Philip, Cincinnati, Ohio. Represented by R. Kelly, N. S. Kenney and D. R. Warfield.

Carnegie Steel Company, Pittsburgh, Pa. Represented by John C. Neale, W. G. Clyde, R. B. Woodworth, H. W. Maxson, N. B. Trist, T. W. Williams, V. S. Yarnall, G. F. Goddard, K. E. Porter, C. B. Friday, John Hornbrook, C. F. W. Rys, I. W. Jenks, Lee Bowman, L. C. Bihler, E. R. Bowen, G. Peterson, L. H. Baker and Charles Orchard.

Carter Iron Company, Pittsburgh, Pa. Represented by H. H. Carter and Henry Gilg.

Champion Rivet Company, Cleveland, Ohio. Represented by W. H. S. Bateman.

Chase & Company, L. C., Boston, Mass. Represented by W. P. Underhill and H. C. Hopewell.

Chicago Car Door Company, Chicago, Ill.. Represented by J. L. Mallory and H. M. Perry.

Chicago Car Heating Company, Chicago, Ill. Represented by Egbert H. Gold, Edward A. Schreiber, B. A. Keeler, F. F. Coggin, G. T. Cooke, R. P. Cooley, E. E. Smith, Jos. Vogel and J. E. Buker.

Chicago-Cleveland Car Roofing Company, Chicago, Ill. Represented by A. S. Lewis, R. C. Dudley, T. N. Russell.

Chicago Pneumatic Tool Company, Chicago, Ill. Represented by C. E. Walker, J. C. Campbell, M. O'Connor, T. G. Smallwood, J. W. McCabe, W. F. Delaney, E. Aplin, A. C. Andresen, Thos. Aldcorn, G. A. Rees, W. P. Presinger, G. A. Barden, W. J. Whalen and J. F. Duntley.

Chicago Railway Equipment Company, Chicago, Ill. Represented by E. B. Leigh, Arthur Wyman, G. N. VanSweringen, C. P. Williams, Edwin F. Leigh, P. B. Harrison and C. H. Williams, Jr.

Chicago Steel Car Company, Chicago, Ill. Represented by H. C. Priebe.

Chicago Varnish Company, Chicago, Ill. Represented by O. H. Morgan, George S. Bigelow, F. L. Olds, Fred J. Gundrum, Jr., and R. K. Buckman, Jr.

Chisholm & Moore Manufacturing Company, The, Cleveland, Ohio. Represented by H. H. Lippincott, H. E. Dickerman, W. J. Radcliffe and J. A. Geismar.

Clarence Brooks & Company, Newark, N. J. Represented by Jacob E. Cope.

Cleveland Car Specialty Company, Cleveland, Ohio. Represented by G. L. Weiss, J. A. Costello.

Cleveland City Forge & Iron Company, Cleveland, Ohio. Represented by W. S. Bidle.

Cleveland Twist Drill Company, Cleveland, Ohio. Represented by W. E. Caldwell, H. O. Swan.

Coe Manufacturing Company, W. H., Providence, R. I. Represented by Benjamin A. Smith and E. J. Arlein.

Collins Metallic Packing Company, Philadelphia, Pa. Represented by G. R. Argo and J. George Wholey.

Colonial Steel Company, Pittsburgh, Pa. Represented by T. E. Hughes, N. C. Einwechter, Chas. M. Brown and E. P. Fitzgerald.

Columbia Nut & Bolt Company, Bridgeport, Conn. Represented by F. Atwater, A. Archer.

Commercial Acetylene Company, The, New York, N. Y. Represented by Oscar F. Ostby, E. T. Sawyer and Roger J. Faure.

Commonwealth Steel Company, St. Louis, Mo. Represented by H. M. Pflager, Geo. E. Howard, C. S. Shallenberger, Boone V. H. Johnson and Blake C. Howard.

"B E D" Stafford, of the Flannery Bolt Co. J. C. Talmadge, of the Talmadge Mfg. Co., Is Trying to Escape in a Rolling Chair.

Left to right—E. C. Anderson, T. E. Coal & Lumber Co.; H. M. Rupp, Engr. Const., Moralia & Tacambaro Ry.; W. S. Allen, Detroit Steel Casting Co., and H. L. Allen, American Steel Foundries.

Edward Beers, Oscar F. Ostby, Roger J. Faure and E. T. Sawyer, of the Commercial Acetylene Co.

American Roll Gold Leaf Co., C. E. Smith, Mgr., and T. T. Lawler.

J. H. McCloy, Zug Iron & Steel Co.; Neil W. Snow, Detroit Twist Drill Co.; F. N. Mason, Universal Flexible Packing Co., and J. M. Crowe, The Railway List Co.

Chas. D. Derby in the Booth of the Joyce-Cridland Co.

Consolidated Car-Heating Company, New York, N. Y. Reperesented by C. C. Nuckols, Thomas Farmer, Jr., W. S. Hammond, Jr., Butler Keys and H. L. Hawley.

Consolidated Railway Electric Lighting & Equipment Company, New York, N. Y. Represented by P. Kennedy, J. L. Watson, L. J. Kennedy, Thomas L. Mount and J. A. Misland.

Crane Company, Chicago, Ill. Represented by F. D. Fenn and G. S. Turner.

Crosby Steam Gage & Valve Company, Boston, Mass. Represented by M. D. Johnson and H. A. Brown.

Crucible Steel Company of America, Pittsburg, Pa. Represented by F. Baskerfield, J. T. Stafford and W. K. Krepps.

Curtain Supply Company, Chicago, Ill. Represented by R. F. Hayes, S. W. Midgley, Geo. E. Fox and F. M. Egolf.

Damascus Brake Beam Company, The, Cleveland, Ohio. Represented by W. W. Quantell and W. H. Winterrowd.

Damascus Bronze Company, Pittsburg, Pa. Represented by Wm. E. Cartwright, John T. Brown.

Davis Boring Tool Company, St. Louis, Mo. Represented by E. E. Davis, L. H. Swind, J. W. McKeen and Walter E. Moberley.

Davis-Bournonville Company, New York, N. Y. Represented by W. R. Noxon, Wm. W. Barnes.

Davis Solid Truss Brake Beam Company, Wilmington, Del. Represented by Nathan H. Davis and Thomas C. Davis.

Dearborn Drug & Chemical Works, Chicago, Ill. Represented by Robert F. Carr, George R. Carr, S. C. Case, Alex Crouch, L. R. Ashhurst, J. E. Weikel, Grant W. Spear, J. D. Purcell and H. G. McConnaughy.

Decatur Car Wheel Company, Atlanta, Ga. Represented by W. F. Newbert, C. C. Esdale.

Deforest Sheet & Tin Plate Company, Niles, Ohio. Represented by Edward D. Thompson and Wade A. Taylor.

Detroit Lubricator Company, Detroit, Mich. Represented by F. W. Hodges, H. I. Lord, A. D. Howard and Chas. E. Holmes.

Detroit Twist Drill Company, Detroit, Mich. Represented by H. Little and N. W. Snow.

Diamond Rubber Company, Akron, Ohio. Represented by L. H. Conger, G. D. Pilgrim.

Dickinson, Paul, Incorporated, Chicago, Ill. Represented by A. J. Filkins and J. A. Meaden.

Dieter Nut Company, New York, N. Y. Represented by P. W. Dieter.

Dixon Crucible Company, Jos., Jersey City, N. J. Represented by L. H. Snyder, J. H. Schermerhorn, H. A. Nealley, H. W. Chase, John Tucker and William Houston.

Dressel Railway Lamp Works, New York, N. Y. Represented by F. W. Dressel, Robert Black, H. S. Hoskinson, E. W. Hodgkins, P. P. Claiborne and F. W. Edmunds.

Duff Manufacturing Company, The, Pittsburgh, Pa. Represented by Edw. A. Johnson and Carl A. Methfessel.

Duntley Pneumatic Tool Company, Chicago, Ill. Represented by J. W. Duntley, Harry Keller and P. H. Gilleland.

Dupont de Nemours Powder Company, E. I., Wilmington, Del. Represented by C. Hallock Silkman.

Durbin Automatic Train Pipe Connector Company, St. Louis, Mo. Represented by V. S. Durbin, J. F. Blackburn, A. H. Burchard, P. Schmidt and J. F. Durbin.

Eagle Glass & Manufacturing Company, Wellsburg, W. Va. Represented by J. L. Fusner.

E. D. E. Company, Chicago, Ill. Represented by Frank M. Gilmore.

Edison Storage Battery Company, Orange, N. J. Represented by W. G. Bee, H. G. Thompson, R. H. Beach, T. V. McGinnis and O. R. Hildebrand.

Edwards Company, The O. M., Syracuse, N. Y. Represented by O. M. Edwards, C. H. Rockwell, E. F. Chaffe, W. C. Bradbury, T. P. O'Brian and Roy T. Axe.

Exhibit of McConway & Torley Co.

C. A. Dunkleberg, of S. F. Bowser & Co.

H. H. Schroyer, of the Acme Ry. Supply Co., and H. U. Morton, of the General Ry. Supply Co.

Vixen Tool Co., Showing the File Testing Machine Where Some Interesting File Tests Were Made.

Morgan K. Barnum, G. S. M. P., Illinois Central R. R.

W. H. Stocks, of the Gold Car Heating & Lighting Co.

W. B. Waggoner Absorbed in the Latest Information from India.

R. L. Mason, of Hubbard & Co.

Electric Controller & Manufacturing Company, Cleveland, Ohio. Represented by R. G. Widdows and E. C. Ryan.

Electric Storage Battery Company, Philadelphia, Pa. Represented by H. E. Hunt.

Emery Pneumatic Lubricator Company, The, St. Louis, Mo. Represented by E. A. Emery, N. J. McAloney and Alex. Steiner.

Edna Brass Manufacturing Company, Cincinnati, Ohio. Represented by J. E. Jackson.

Ehret Magnesia Manufacturing Company, Philadelphia, Pa. Represented by B. F. Conwell.

Enterprise Railway Equipment Company, Chicago, Ill. Represented by Argyle Campbell.

Ewald Iron Company, Louisville, Ky. Represented by S. F. Sullivan, H. E. Pierce, R. F. Kilpatrick.

Fabrikoid Works, Wilmington, Del. Represented by H. W. Wivel.

Faessler, J., Manufacturing Company, Moberly, Mo. Represented by C. F. Palmer, J. W. Faessler.

Fairbanks Company, The, New York, N. Y. Represented by J. R. Meginnis, L. B. Mann, F. Mattern.

Fairbanks-Morse & Co., Chicago, Ill. Represented by A. A. Taylor, E. M. Fisher, C. T. Fugitt, W. W. Conrad and F. H. Douglas.

Flannery Bolt Company, Pittsburgh, Pa. Represented by J. Rogers Flannery, Jas. J. Flannery, Wm. M. Wilson, B. E. D. Stafford, J. W. McConnell, T. L. Leahey, Thos. R. Davis and Geo. E. Howard.

Flood & Conklin Company, Newark, N. J. Represented by H. S. Shields.

Forged Steel Wheel Company, New York, N. Y. Represented by C. T. Bacon, Jr.

Forsyth Brothers Company, Chicago, Ill. Represented by Wm. Wampler and A. H. Lisser.

Ft. Pitt Malleable Iron Company, Pittsburgh, Pa. Represented by Frank J. Lanahan.

Foster Company, The Walter H., New York, N. Y. Represented by Walter H. Foster and Herbert R. Kenah.

Franklin Manufacturing Company, The, Franklin, Pa. Represented by R. J. Evans, H. S. Hayden, E. R. Rayburn and H. S. Hayward.

Franklin Railway Supply Company, New York, N. Y. Represented by J. S. Coffin, F. W. Martin, S. G. Allen, R. G. Coburn, W. L. Allison, C. L. Winey, W. H. Coyle and J. L. Mohun.

Frost Railway Supply Company, The, Detroit, Mich. Represented by Harry W. Frost and George L. Harvey.

Galena-Signal Oil Company, Franklin, Pa. Represented by E. H. Baker, W. A. Trubee, Geo. L. Morton, Wm. Holmes, W. J. Walsh, J. E. Hall, B. H. Grundy, C. C. Steinbrenner, E. V. Sedgwick, H. Hillyer, W. E. Augur, W. W Breckenridge, W. E. Brumble, J. W. Bunn, J. A. Graham, E. W. Grieves, G. E. McVicar, C. H. Thomas, F. A. Guild, W. E. Maher, A. V. Manchester, R. F. Menefee, C. G. Melvin, L. H. Palmer, E. M. Hedley, J. G. Arn, W. O. Taylor, W. J. Vance and A. B. Wright.

Gardiner, J. T., Company, Chicago, Ill. Represented by Jas. T. Gardiner.

Garlock Packing Company, The, Palmyra, N. Y. Represented by H. N. Winner, J. P. Landreth, T. P. Dunham, J. F. Franey.

General Electric Company, Schenectady, N. Y. Represented by J. W. Ham, C. D. Knight, Frank Rhea, R. E. Wooley, C. Fair, L. W. Shugg, R. A. Lewis, W. J. Clark, W. O. Kellogg, C. A. Raymond, A. I. Totten.

General Railway Supply Company, Chicago, Ill. Represented by H. U. Morton, W. S. Humes, T. Y. Miller and J. F. Oelerich.

Gilbert & Barker Manufacturing Company, Springfield, Mass. Represented by H. C. Worrall.

J. M. Odenheimer, of the Penn. Flexible Metallic Tubing Co.

Messrs. Fuller and Barker, of the Locomotive Improvement Co.

W. T. Dunning and His Spiritual Advisor.

H. Rawcliffe, Sales Mgr., Vixen Tool Co.

M. G. Sperzel, of the Vixen Tool Co.

Geo. Bryant, of Thos. Prosser & Sons, and John T. Chamberlain, Formerly M. C. B. of the B. & A. Bryant is trying to sell another dog.

B. L. Greenwood, G. F. L. D., Seaboard Air Line.

Gold Car Heating & Lighting Company, New York, N. Y. Represented by Edward E. Gold, E. B. Wilson, A. B. Strange, F. A. Purdy, W. H. Stocks, A. D. Stuver, J. M. Stayman, George F. Ivers, F. H. Smith, E. J. Ronan, A. E. Robbins, F. T. Kitchen and F. O. Bailey.

Goldschmidt Thermit Company, New York, N. Y. Represented by Dr. Hans Goldschmidt, Wm. C. Cuntz, H. S. Mann, H. D. Kelley and J. G. McCarty.

Goodrich, B. F., Company, Akron, Ohio. Represented by F. O. Stuts, C. M. Woodruff.

Gould Coupler Company, New York, N. Y. Represented by F. P. Huntley, Geo. G. Milne, Dr. C. W. Gould, W. T. Sherman, J. W. Jepson, Clarence E. Rood, Geo. S. Berger and W. F. Richards.

Gould & Eberhardt, Newark, N. J. Represented by Fred L. Eberhardt, H. Ezra Eberhardt and Chas. L. Cameron.

Graves, N. Z., Company, Philadelphia, Pa. Represented by H. C. Carpenter, F. J. Graves, W. W. Magowan.

Great Western Smelting & Refining Company, Chicago, Ill. Represented by Louis Turivas.

Greene, Tweed & Company, New York, N. Y. Represented by F. E. Ransley and L. J. Van De Wall.

Greenlaw Manufacturing Company, The, Boston, Mass. Represented by H. A. Royce and A. L. Greenlaw.

Griffin Wheel Company, Chicago, Ill. Represented by C. K. Knickerbocker, H. N. Scott, Geo. D. Casgrain, W. A. Bennett and A. A. Hale.

Grinden Art Metal Company, Brooklyn, N. Y. Represented by Wm. J. Grinden and Frank V. Grinden.

Grip Nut Company, Chicago, Ill. Represented by E. R. Hibbard, J. W. Hibbard, W. E. Sharp, W. G. Wilcoxson, DeF. Lillis and Clifford Beaumont.

Halcomb Steel Company, Syracuse, N. Y. Represented by Thomas J. Moore, Jr.

Hale & Kilburn Company, Philadelphia, Pa. Represented by V. von Schlegell, J. K. Hoffman, C. W. Laskay, J. G. Bower, I. Lubersky, A. F. Old, F. C. Edson, J. C. Dunphy and F. F. Robb.

Hammett, H. G., Troy, N. Y. Represented by H. G. Hammett and E. C. Sawyer.

Hanlon Locomotive Sander Company, Winchester, Mass. Represented by W. J. Hanlon.

Hansen, Riley & Company. Represented by S. H. Riley.

Harrington, Son & Company, Inc., Edwin, Philadelphia, Pa. Represented by W. J. Somerset, A. M. Harrington and Roger Sherron.

Hartshorn Company, Stewart, H., Newark, N. J. Represented by B. E. Bushnell and Stewart Hartshorn.

Hewitt, H. H., New York, N. Y. Represented by H. H. Hewitt, G. Anthony, E. C. Tourtelot, L. A. Weary, H. E. Sall, C. M. Hewitt and C. M. Bower.

Heywood Brothers & Wakefield Company, Wakefield, Mass. Represented by Bertram Berry, Scot Wade, C. W. H. Frederick and E. C. Lang.

Higley Machine Company, New York, N. Y. Represented by C. H. Hamersly.

Hildreth Varnish Company, New York, N. Y. Represented by F. G. A. Rice.

Home Rubber Company, Trenton, N. J. Represented by A. R. Foley.

Hubbard & Company, Pittsburgh, Pa. Represented by John W. Hubbard and R. L. Mason.

Hunt Company, C. W., West New Brighton, N. Y. Represented by A. C. Summers and J. Day Flack.

Hunt-Spiller Manufacturing Corporation, South Boston, Mass. Represented by W. B. Leach, Frederick Parker, J. G. Platt, F. H. Stone, V. W. Ellet and J. M. Monroe.

Hutchins Car Roofing Company, Detroit, Mich. Represented by A. R. Wilson, D. W. Hawksworth, W. D. Thompson.

O. S. Jackson, S. M. P., Chi. T. H. & S. E., and J. W. Fogg, M. M., B. & O. Chi. Terminal.

Jos. Quigley, M. M., C. N. O. & T. P., and Wife.

John MacKenzie, of the Johnson Wrecking Frog Co., and Andrew Chambers.

Prof. L. E. Endsley, of Purdue University.

Independent Pneumatic Tool Company, Chicago, Ill. Represented by W. O. Jacquette, John D. Hurley, R. S. Cooper, George A. Gallinger, R. T. Scott, J. J. Keefe, J. P. Bourke, T. J. Carroll, F. H. Charbono, A. Levedahl, H. F. Finney, H. H. Hendricks.

Industrial Requirements Company, Philadelphia, Pa. Represented by E. Boyd Weitzel and A. P. Fisk.

Ingersoll-Rand Company, New York, N. Y. Represented by G. B. Roser.

International Steam & Pump Company, New York, N. Y. Represented by P. B. Fenlon, T. C. McBride.

Jacobs-Shupert U. S. Fire Box Company, The, Coatesville, Pa. Represented by C. B. Moore, W. L. Bean and A. W. Whitford.

Jenkins Bros., New York, N. Y. Represented by B. J. Neely, C. B. Yardley and Alfred Engle.

Jerguson Gage & Valve Company, Boston, Mass. Represented by P. A. Jerguson.

Jessop & Sons, Incorporated, William, New York, N. Y. Represented by John E. Sandmeyer, E. M. Britton and T. S. Hanna.

Jones, B. M., Company, Boston, Mass. Represented by C. J. Poore, S. T. Peasons, Jas. A. Warren, R. L. Thomas, J. N. Moore.

Jones Car Door Company, Chicago, Ill. Represented by D. B. Jones.

Johnson Manufacturing Company, Urbana, Ohio. Represented by I. T. Johnson.

Johns-Manville Company, H. W., New York, N. Y. Represented by J. E. Meek, G. A. Nicol, C. W. Gearhart, J. H. Trent, F. J. Horne, J. C. Younglove, H. G. Newman, C. E. Murphy and P. C. Jacobs.

Joliet Railway Supply Company, Chicago, Ill. Represented by A. G. Bancroft and F. A. Lester.

Jones & Laughlin Steel Company, Pittsburgh, Pa. Represented by J. K. Barker, C. S. Bradley, Roland Gerry, T. C. Ham, H. F. Holloway, A. B. Marble, George B. Mitchell, W. T. Mossman and Frank S. Slocum.

Joyce-Cridland Company, The, Dayton, Ohio. Represented by Geo. M. Llewellyn, Chas. D. Derby and P. J. Ford.

Kay & Ess Company, Dayton, Ohio. Represented by H. G. Kittredge, W. G. Bittner.

Keystone Drop Forge Works, Chester, Pa. Represented by Geo. H. Berlin and Chas. F. H. MacLaughlin.

Keystone Lubricating Company, Philadelphia, Pa. Represented by A. C. Buzby, W. F. Buzby, W. E. Harrington, T. O. Organ and J. T. Butler.

Knight Pneumatic Sander Company, Huntington, Ind. Represented by R. G. Mitchell and Daniel Shaeff.

Laconia Car Company, Boston, Mass. Represented by C. S. Hawley.

Landis Machine Company, Waynesboro, Pa. Represented by Ira D. Grove, Carl F. Meyer and J. W. Willis.

Lawrence, W. W., & Company, Pittsburg, Pa. Represented by Will H. Rowand.

Lehon Company, The, Chicago, Ill. Represented by Thomas Lehon.

Locomotive Improvement Company, The, Clinton, Iowa. Represented by L. W. Barker and E. J. Fuller.

Locomotive Superheater Company, New York, N. Y. Represented by Simon Hoffmann, George L. Bourne, Gilbert E. Ryder, H. B. Oatley, W. A. Buckbee and William Boughton.

Long, Chas. R., Jr., Company, Louisville, Ky. Represented by S. W. Russel, H. L. Bell, H. Vissering, Chas. R. Long, Jr.

Lucas Machine Tool Company, Cleveland, Ohio. Represented by W. L. Cheney and J. A. Leighton, Jr.

Lunkenheimer Company, The, Cincinnati, Ohio. Represented by W. M. Hood, Lane Thompson and Elmer Ritter.

McConway & Torley Company, The, Pittsburgh, Pa. Repre-

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McCord Manufacturing Company, Chicago, Ill. Represented by Benjamin S. McClellan and Robert A. Flum.

McCuen, J. P., Cincinnati, Ohio. Represented by J. P. McCuen.

McGraw Publishing Company, New York, N. Y. Represented by Hugh M. Wilson, D. T. Pierce, Henry W. Blake, Walter Jackson, Frank Kingsley, C. A. Babtiste, W. K. Beard, Harold Rudd and Joseph A. Kucera.

McIlvain, J. Gibson, & Company. Represented by C. F. Macrae, J. G. McIlvain.

Magnus Metal Company, New York, N. Y. Represented by M. S. Paine.

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Manning, Maxwell & Moore, Inc., New York, N. Y. Represented by Frank P. Smith, E. J. Spaett, P. M. Brotherhood, Kester Barr, Robert A. Bole, W. H. McIntyre, J. N. Derby, H. P. Eilers, L. H. Mesker, M. A. Sherritt, Joseph H. Bush, John J. Faas, Charles L. Brown, P. J. March, Jr., W. F. Blandin, J. A. Benson, W. B. Chase, Thos. Stephens, W. H. Williston, F. C. Blanchard, C. A. Moore and B. T. Williston.

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Mid-Western Car Supply Company, Chicago, Ill. Represented by J. E. Forsyth, Geo. E. Pratt and A. L. Jacobs.

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Miner, W. H., Chicago, Ill. Represented by Geo. A Johnson, S. R. Fuller, Jr., J. R. Mitchell, W. H. Miner, W. E. Robertson, J. F. O'Connor.

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Nathan Manufacturing Company, New York, N. Y. Represented by Alfred Nathan, Edward S. Toothe, J. C. Currie, Otto Best, J. S. Seeley, L. Kassander and Edward Laterman.

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National Car Wheel Company, Pittsburg, Pa. Represented by J. H. Yardley, E. H. Chapin.

National Lock Washer Company, The, Newark, N. J. Represented by F. B. Archibald, R. L. Brown, W. C. Dodd, J. H. Horn and D. Hoyt.

National Malleable Castings Company, The, Cleveland, Ohio. Represented by F. R. Angell, T. Aishton, C. A. Bieder, W. E. Coffin, C. Gasper, R. T. Hatch, H. D. Hammond, J. H. Jaschka, G. V. Martin, Benj. Nields, Jr., J. H. Slawson, L. S. Wright and E. O. Warner.

National Tube Company, Shelby Steel Tube Company, Pittsburgh, Pa. Represented by L. R. Phillips, G. N. Riley, P. J. Conrath, O. H. Kelly, J. T. Goodwin, J. A. Dillon, J. O. Ramsey, L. R. Cummings, J. G. Bateman, W. S. Bitting, J. E. Fleming and B. F. Bart.

Nelite Works of General Electric Company, Cleveland, Ohio. Represented by Arthur J. Sweet, L. C. Doane, G. M. Smith and N. B. Hazeltine.

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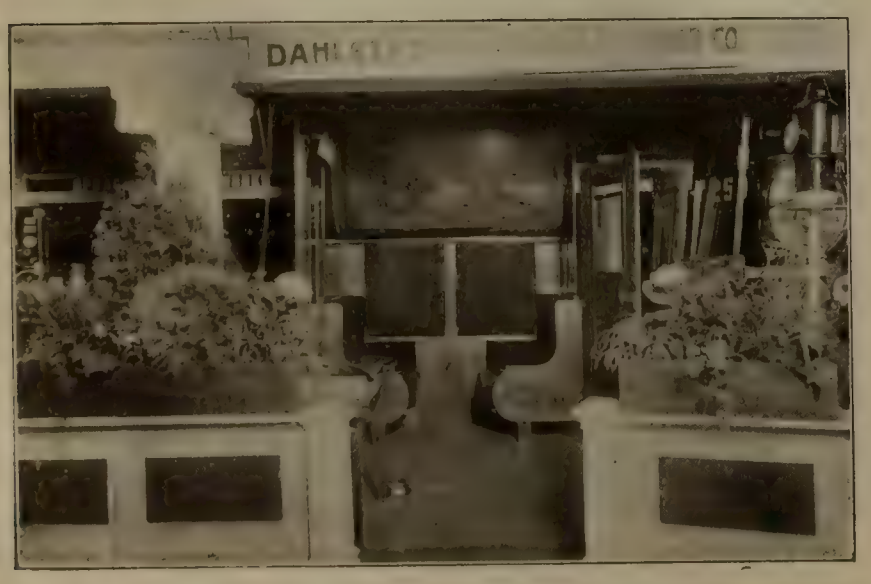

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Newhall Engineering Company, George M., Philadelphia, Pa. Represented by David Newhall, Morton L. Newhall, William L. Brown and William Waring.

Newton Machine Tool Works, Philadelphia, Pa. Represented by H. W. Champion and N. P. Lloyd.

New York Air Brake Company, The, New York, N. Y. Represented by H. F. Bickel, W. T. Henry, C. E. Leach, B. J. Minnier, B. Pratt and F. M. Whyte.

New York Belting & Packing Company, New York, N. Y. Represented by J. F. Purtell, E. W. Thompson.

Nickel-Chrome Chilled Car Wheel Company, Pittsburgh, Pa. Represented by Robert C. Totten and Stephen D. Barnett.

Niles-Bement-Pond Company, New York, N. Y. Represented by James K. Cullen, George F. Mills, Charles L. Lyle, J. T. McMurray, E. S. Cullen, J. P. Ilsley, Wm. B. Page and Edward L. Leeds.

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Norton Grinding Company, Worcester, Mass. Represented by C. O. Smith, Charles H. Norton and H. N. Cudworth.

Norton, Inc., A., Boston, Mass. Represented by H. J. Wilson, R. D. Bates, C. O. Smith and H. A. Norton.

O'Malley-Beare Valve Company, Chicago, Ill. Represented by Thomas O'Malley.

Otis Steel Company, Cleveland, O. Represented by Geo. E. Sevey, H. J. Deverell.

Oxweld Acetylene Company, Chicago, Ill. Represented by W. J. Knapp, G. E. Kershaw, W. J. Fritz and J. A. Warfel.

Pantasote Company, The, New York, N. Y. Represented by John M. High, W. A. Lake and A. S. Barrows.

Parkesburg Iron Company, The, Parkesburg, Pa. Represented by H. A. Beale, Jr., W. H. S. Bateman, C. L. Humpton, H. C. Hunter, G. W. Denyven, J. A. Kinkead, L. P. Mercer, J. H. Smythe and George Thomas, 3d.

Pease Company, The C. F., Chicago, Ill. Represented by C. F. Pease, T. K. Murney and J. J. Nevlin.

Peerless Rubber Manufacturing Company, New York, N. Y. Represented by J. S. Hungerford, F. Donnell, G. R. Kyles.

Pennsylvania Flexible Metallic Tubing Company, New York, N. Y. Represented by J. M. Odenheimer, M. P. McLaughlin and C. A. Meyer.

Pennsylvania Steel Castings & Machine Company, Philadelphia, Pa. Represented by J. B. Zell.

Pilliod Company, The, New York. Represented by R. H. Weatherly, F. S. Wilcoxen and R. F. Darby.

Pittsburg Spring & Steel Company, Pittsburg, Pa. Represented by D. C. Noble, J. W. Browning, K. A. Heine, M. F. Ryan, G. A. Jones.

Pittsburgh Steel Foundry Company, Pittsburgh, Pa. Represented by F. E. Lewis, H. V. Seth and O. S. Pulliam.

Pneumatic Jack Company, Inc., Louisville, Ky. Represented by J. S. Leake.

Pocket List of Railroad Officials, The, New York. Represented by J. Alexander Brown, Harold A. Brown and Chas. L. Dinsmore.

Post, E. L., & Company, New York, N. Y. Represented by F. O. Ketcham.

Pratt & Lambert Varnish Company, Buffalo, N. Y. Represented by J. P. Gowing, C. L. McMaster, Jas. Maycock.

Pressed Steel Car Company, New York, N. Y. Represented by J. C. Anderson, L. O. Cameron, O. C. Gayley, H. S. Hammond, C. A. Lindstrom, J. F. MacEnulty, C. E. Postlethwaite, M. S. Simpson, J. S. Turner, W. H. Wilkinson, B. D. Lockwood and F. L. Johnson.

Prosser, Thos., & Son, New York, N. Y. Represented by Geo. H. Bryant, F. A. Barley, Thos. Prosser.

Protectus Paint Company, Philadelphia, Pa. Represented by W. C. De Armond, J. F. Walker.

Pyle-National Electric Headlight Company, Chicago, Ill. Rep-

resented by H. P. Bayley, M. A. Ross, J. Will Johnson, H. H. Gilbert, C. P. McGinnie and Chas. W. Drake.

Pyrene Manufacturing Company, New York, N. Y. Represented by E. M. Davidson, George H. Peterson and Thomas Areson.

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Q. & C. Company, New York, N. Y. Represented by C. E. Quincy, T. B. Bowman, H. E. McColumbia.

Quigley Furnace & Foundry Company, Springfield, Mass. Represented by W. S. Quigley.

Railway Age Gazette, New York, N. Y. Publishers of the Railway Age Gazette, American Engineer, and The Signal Engineer. Represented by E. A. Simmons, L. B. Sherman, Samuel O. Dunn, Bradford Boardman, C. R. Mills, Henry Lee, Roy V. Wright, William Forsyth, R. E. Thayer, F. S. Dinsmore, Wm. D. Horton, W. W. Newcomb, A. E. Hooven, F. H. Thompson, E. A. Averill, W. D. Horton and K. G. Cloud.

Railway & Engineering Review, Chicago, Ill. Railway publication. Represented by Willard A. Smith, P. G. Stevens, Harold A. Smith and J. M. Lammedee.

Railway Electrical Engineer, Chicago, Ill. Railway publication. Represented by Edward Wray.

Railway List Company, The, Chicago, Ill. Publishers of the Railway Master Mechanic, Monthly Official Railway List and Railway Engineering and Maintenance of Way. Represented William E. Magraw, Chas. S. Myers, L. F. Wilson, J. M. Crowe and O. W. Middleton.

Railway Materials Company, Chicago, Ill. Represented by T. B. Cram, Geo. Hoeffle and H. T. Mercur.

Railway Utility Company, Chicago, Ill. Represented by Wm. J. Pine, Lee P. Hynes, C. A. Luckey and E. R. Field.

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Reading Car Wheel Company, Buffalo, N. Y. Represented by S. J. Sill.

Reliance Electric and Engineering Company, Cleveland, Ohio. Represented by H. M. Hitchcock, D. G. Darling, E. A. Lewis and S. C. Potter.

Remy Electric Company, Anderson, Ind. Represented by T. B. Arnold and G. V. Bain.

Republic Rubber Company, Youngstown, Ohio. Represented by J. H. Kuhns.

Restein Company, Clement, Philadelphia, Pa. Represented by H. O. Fettinger, Norman B. Miller and W. J. Cromie.

Richmond Staybolt Drilling Machine Manufacturing Company, Richmond, Va. Represented by E. W. Fishburne.

Robinson Coupler Company, The, Washington, D. C. Represented by W. S. Rose and Clinton M. Smith.

Rochester Germicide Company, Rochester, N. Y. Represented by C. L. Pearson and C. S. Whitman.

Rubberset Company, Newark, N. J. Represented by G. Slate and A. L. Holtzman.

Safety Car Heating and Lighting Company, New York, N. Y. Represented by R. M. Dixon, A. C. Moore, J. S. Henry, Geo. E. Hulse, E. E. Allbee, Wm. L. Garland, Chas. B. Adams, J. G. Van Winkle, Geo. H. Chadwell, M. F. Elliott, R. H. Harvey, A. B. Mills, R. C. Shaal, L. Schepmoes and J. M. Towne.

St. Louis Car Company, St. Louis, Mo. Represented by H. T. Vogel, J. J. Morse.

Sargent Company, Chicago, Ill. Represented by Frank G. Dunbar and George H. Sargent.

Scarrett-Comstock Furniture Company, St. Louis, Mo. Represented by C. C. Taylor.

Scullin-Gallagher Iron & Steel Company, St. Louis, Mo. Represented by Frank L. Norton, G. L. L. Davis, H. H. Waldron, R. A. Dugan, H. Scullin and L. A. Shepard.

Gold Car Heating & Lighting Co. Standing: F. H. Smith, A. M. Robbins, Jno. Johnson, A. D. Stuver, F. A. Kitchen, F. A. Purdy and E. Ronan. Seated: J. M. Stayman, Ed. E. Gold (Pres.), A. B. Strange, W. H. Stocks and Geo. Ivers.

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Sellers & Company, Wm., Incorporated, Philadelphia, Pa. Represented by John D. McClintock, Charles T. Wilson, E. L. Holljes, Clinton B. Conger and Walter W. Storm.

Shelby Steel Tube Company.

Sherwin-Williams Company, Cleveland, Ohio. Represented by R. L. Graves, E. M. Richardson, W. B. Albright, Thos. Madill, E. L. Elinquist.

Simplex Railway Appliance Company, Chicago, Ill.

Sinclair Company, Angus, New York, N. Y. Publishers of Railway & Locomotive Engineering. Represented by Angus Sinclair and A. G. Wood.

Sipe, Jas. B., & Company, Pittsburg, Pa. Represented by W. F. Robinson, D. B. Vail.

Sprague Electric Works of the General Electric Company, New York, N. Y. Represented by A. E. Braddell and H. W. Uhl.

Spencer-Otis Company, Chicago, Ill. Represented by C. Blatchford.

Standard Car Truck Company, Chicago, Ill. Represented by J. C. Barber, F. L. Barber and James T. Milne.

Standard Coupler Company, New York, N. Y. Represented by A. P. Dennis, E. H. Walker, R. D. Gallagher, Jr., and George A. Post, Jr.

Standard Paint Company, New York, N. Y. Represented by J. H. Thomas, J. E. Brown.

Standard Railway Equipment Company, St. Louis, Mo. Represented by S. D. Anderson.

Standard Roller Bearing Company, Philadelphia, Pa. Represented by J. G. Cooley and M. G. Sperzel.

Standard Steel Car Company, New York, N. Y. Represented by J. B. Brady, Wm. Libkeman, R. L. Gordon, C. W. Wright, R. Radford, S. B. Elkins, H. G. Macdonald, J. E. Bradley and E. S. Keith.

Steel Specialties Company, Boston, Mass. Represented by A. L. Cole.

Star Brass Manufacturing Company, Kalamazoo, Mich. Represented by M. A. Fish, G. H. Musgrave.

Storrs Mica Company, Owego, N. Y. Represented by C. M. Thompson, A. P. Storrs and Charles P. Storrs.

Street, Clement F., Schenectady, N. Y. Represented by Clement F. Street, T. R. Brown, N. M. Lower and Chas. F. Gernert.

Strong-Carlisle & Hammond Company, Cleveland, O. Represented by B. E. Carpenter.

Symington Company, The T. H., Baltimore, Md. Represented by T. H. Symington, C. J. Symington, I. O. Wright, B. S. Johnson, T. C. de Rossett, M. K. Kimberly, A. H. Weston and D. F. Mallory.

Tabor Manufacturing Company, The, Philadelphia, Pa. Represented by H. W. Brown.

Tate, Jones & Company, Pittsburg, Pa. Represented by F. W. Trimble.

Templeton, Kenly & Company, Ltd., Chicago, Ill. Represented by W. B. Templeton and Arthur C. Lewis.

Texas Company, Houston, Tex. Represented by J. F. Jordon.

Topping Brothers, New York, N. Y. Represented by William E. Hansen and Charles L. Crabb.

Tousey Varnish Company, Chicago, Ill. Represented by O. C. Hayward.

Transportation Utilities Company, New York, N. Y. Represented by W. L. Conwell and H. B. Chamberlain.

Tyler Company, The W. S., Cleveland, Ohio. Represented by G. E. Molleson and L. D. Winters.

Union Draft Gear Company, Chicago, Ill. Represented by J. R. Cardwell, L. T. Canfield, W. G. Krauser, J. E. Tarelton and J. W. Hathaway.

Union Petroleum Company, Philadelphia, Pa. Represented by O. C. Lippincott.

Union Spring & Manufacturing Company, Pittsburgh, Pa. Represented by L. Woods, H. B. Darlington, Chas. S. Foller, A. C. Woods, A. Stucke, W. F. LaBonta and H. F. Ayres.

In the Center is the New President of the Railway Supplymen, Samuel G. Allen. At his Right is W. L. Allison and at His Left, R. G. Coburn. All Are With the Franklin Railway Supply Co.

Chas. F. Pierce of the Chemical Condenser Co. and Dr. Griffin of the Wheel Truing Brake Shoe Co.

The Grip Nut Bunch: J. W. Hibbard, E. R. Hibbard, De. F. Lillis, W. E. Sharp and C. Beaumont.

J. Allen Smith of the U. S. Light & Heating Co.

Stephen C. Mason and the McConway Steel Wheel.

H. M. Perry and J. L. Mallory of the Chicago Car Door Co. and J. Maycock of Pratt & Lambert.

E. J. Arlein and B. A. Smith of W. H. Coe Mfg. Co. Frank Gregg of Adams & Westlake Co

Universal Draft Gear Attachment Company, Chicago, Ill. Represented by C. J. Nash and C. C. Kinsman.

United States Light & Heating Company, The, New York, N. Y. Represented by W. P. Hawley, D. W. Pye, J. Allen Smith, W. L. Bliss, L. S. Cunny, A. Russell, R. S. Bryan and C. L. Lane.

U. S. Metal & Manufacturing Company, New York, N. Y. Represented by B. A. Hegeman, Jr., Chas. C. Castle, E. D. Hillman, F. C. Dunham, H. A. Hegeman, J. J. Ross and H. K. Porter.

United States Metallic Packing Company, The, Philadelphia, Pa. Represented by Morris B. Brewster, C. B. Ford, Elliott Gurtiss, John S. Mace, Harry M. Wey and C. L. Mellor.

United States Metal Products Company, New York, N. Y. Represented by F. D. Ward, J. Harron and S. A. Walker.

Valentine & Company, New York, N. Y. Represented by Langdon B. Valentine, Lawson V. Pulsifer, I. H. Munford and J. E. Ham.

Van Dorn & Dutton Company, The, Cleveland, Ohio. Represented by Franklin Schneider, F. W. Sinram, A. K. Baxter and W. T. Van Dorn.

Vandyke-Churchill Company, New York, N. Y. Represented by Chas. F. White.

Virginia Equipment Company, Toledo, Ohio. Represented by Lacy Y. Williams and Grafton A. Dodd.

Vixen Tool Company, Philadelphia, Pa. Represented by Walter D. Craft and H. Rawcliffe.

Ward Equipment Company, New York, N. Y. Represented by George B. Culver, J. F. Deems, Peter Fink, Charles E. Lowell, Rolland B. Lowther, C. F. McCuen, Lewis B. Rhodes, John E. Ward and A. L. Whipple.

Warner & Swasey Company, The, Cleveland, Ohio. Represented by C. J. Stilwell.

Watson-Stillman Company, New York, N. Y. Represented by F. H. Clark, E. A. Stillman.

Welsbach Company, Gloucester, N. J. Represented by Alphonso Mason, Chas. W. Wardell and J. Stetser.

West Disinfecting Company, New York, N. Y. Represented by Geo. L. Lord and H. E. Daniels.

Western Electric & Manufacturing Company, New York, N. Y. Represented by Chas. R. Harrison, Geo. H. Porter.

Western Railway Equipment Company, St. Louis, Mo. Represented by Louis A. Hoerr, Sterling Campbell and R. L. Langtion.

Westinghouse Air Brake Company Pittsburgh, Pa. Represented by A. L. Humphrey, E. A. Craig, T. L. Burton, Jos. R. Ellicott, F. V. Green, F. M. Nellis, C. J. Olmstead and R. P. Noble.

Westinghouse, Church, Kerr & Company, New York, N. Y. Represented by W. G. Clark and H. H. Kerr.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Represented by F. H. Herzsch, H. C. Mode, R. E. S. Geare, R. F. Moon and F. W. Harrison.

Westinghouse Machine Company, The, East Pittsburgh, Pa. Represented by E. H. Sniffin.

Wheel Truing Brake Shoe Company, Detroit, Mich. Represented by J. M. Griffin.

Whiting Foundry Company, Harvey, Ill. Represented by C. A. Hardy.

Wiley, C. A., Company, Long Island City, N. Y. Represented by J. B. Hicks.

Williams Company, Inc., G. H., Cleveland, Ohio. Represented by G. H. Williams and J. J. Williams.

Wilmarth & Morman Company, Grand Rapids, Mich. Represented by Chas. E. Meech, B. Saunders and C. H. Slaughter.

Wilson Remover Company, New York, N. Y. Represented by J. MacNaull Wilson and J. Whitney Wilson.

Wood, Guilford S., Chicago, Ill. Represented by T. P. Gaskins, J. B. Kirtley and D. F. Jennings.

Wood, R. D., & Company, Philadelphia, Pa. Represented by H. A. Jensenius.

Woods, Edwin S., & Company, Chicago, Ill. Represented by Chas. D. Jenks.

Worth Bros., Coatesville, Pa. Represented by Chas. Shults, R. D. Shults, F. R. Shults, B. A. Clements.

Yale & Towne Manufacturing Company, The, New York, N. Y. Represented by R. T. Hodgkins, W. A. Hall, A. W. Patterson, Jr., D. A. Wright, F. A. Maycumber, J. F. Stoldt and H. H. Ricketts.

Zug Iron & Steel Company, Pittsburgh, Pa. Represented by John H. McCloy.

Ashton Valve Company, Boston, Mass. Represented by Albert C. Ashton, Jos. F. Gettrust and Jos. W. Motherwell.

United Equipment Company, New York, N. Y. Represented by Lucian C. Brown.

Philip S. Justice & Company, Philadelphia, Pa. Represented by Philip J. Mitchell.

Wendell & MacDuffie Company, New York, N. Y. Represented by H. E. Oesterreich.

Flint Varnish Company, Flint, Mich. Represented by L. J. Hibbard and C. Clark.

Ohio Injector Company, Chicago, Ill. Represented by Wm. S. Furry and Frank W. Furry.

Love Bros. Company, Aurora, Ill. Represented by C. L. Woodruff.

Patton Paint Company, Milwaukee, Wis. Represented by Jas. G. Mowry.

Magnus Metal Company, New York, N. Y. Represented by F. E. Beal.

Cowles-MacDowell Engr. Company, Chicago, Ill. Represented by Chas. L. Sullivan.

American Steam Gauge & Valve Company, Boston, Mass. Represented by H. Parker.

Pressed Prism Company, Morgantown, W. Va. Represented by L. R. Waterman, A. O. Brown.

Left to right: C. A. Crone and T. E. Corliss of the Buffalo Brake Beam Co.; C. M. Mendenhall of the Buckeye Steel Castings Co.

J. M. Tate, Jr., Pres. Tate-Jones & Co., Inc. F. W. Trimble, New York Representative, and F. J. McCarty, Furnace Designer and Sales Engineer.

Booth of Stewart H. Hartshorn Co. B. E. Bushnell at the Left.

Standing: R. E. S. Geare, Westinghouse Electric & Mfg. Co.; F. S. Fisher, Westinghouse Lamp Co.; E. M. Wise, Westinghouse Elec'l & Mfg. Co. Seated: F. H. Herzsch, Westinghouse Elect. & Mfg. Co., Joe Andreucetti, C. & N. W. Ry.; A. J. Cole, Westinghouse Lamp Co.

Frederick Maley Explaining the Milburn Light. C. R. Pollard and W. J. McCauley Are Looking This Way.

Personals

H. W. Jacobs, for six years assistant superintendent of motive power of the Atchison, Topeka & Santa Fe, has resigned to engage in private business.

Frank W. Morse, vice-president and general manager of the Chicago & Alton, has resigned, his duties being taken over temporarily by B. A. Worthington. Mr. Worthington recently succeeded T. P. Shonts as president of the road.

F. B. Miller succeeds Geo. H. Barnes as superintendent of the Denver Northwestern & Pacific with office at Denver, Colo. The office of trainmaster has been abolished.

F. L. Hay has been appointed superintendent of the dining and sleeping car department of the Great Northern with office at St. Paul. He succeeds T. A. Forbes.

W. M. Whitenton, general manager of the Rock Island, has had his jurisdiction extended over the St. Paul & Kansas City Short Line. F. C. MacMillan of the latter road will still retain the title of vice-president. The jurisdiction of the mechanical department of the Rock Island has also been extended over the Short Line.

E. Thomas has been appointed assistant superintendent of the Union R. R. with office at Port Perry, Pa.

W. L. Blair has been appointed assistant to the general manager of the New York, Chicago & St. Louis with office at Cleveland. R. W. Mitchener has been appointed superintendent of transportation and G. C. Todd has been appointed superintendent of the Cleveland division, both with office at Cleveland.

S. D. Warriner has been elected president of the Panther Creek R. R. with office at Philadelphia, Pa.

John McClain has been appointed master mechanic of the Pittsburg, Lisbon & Western with office at New Gallilee, Pa.

C. M. Chalker succeeds C. L. McLane as general foreman car department of the National Railways of Mexico. Titles of road foremen of engines on this road have been changed to assistant superintendents of locomotive service.

B. A. Aikens has been appointed purchasing agent of the Michigan Central, succeeding J. F. Farrell. His office is at Detroit, Mich.

F. W. Johnson has been appointed master mechanic of the Nevada Copper Belt with office at Mason, Nev.

W. H. Berger succeeds Wm. Pearson as superintendent of motive power of the Indian Creek Valley with office at Connellsville, Pa.

A. J. Burch has been appointed superintendent of the Gallatin Valley with office at Bozeman, Mont.

M. Donaldson has been appointed vice-president and general manager of the lines west of Ft. William of the Grand Trunk Pacific. His headquarters are at Winnipeg, Man.

C. A. Gill has been appointed master mechanic of the Cincinnati, Hamilton & Dayton with office at Ivorydale, Ohio, and W. G. Rose has been appointed master mechanic at Indianapolis.

W. J. Potts succeeds J. W. Collins as purchasing agent of the Central Ontario with office at Trenton, Ont.

W. L. Derr has been appointed superintendent of the western division of the Chicago Great Western with headquarters at Clarion, Ia. He succeeds F. R. Blunt, resigned.

J. R. Gould succeeds J. F. Walsh as general superintendent of motive power of the Chesapeake & Ohio with office at Richmond, Va. Mr. Walsh retires at his own request, but will remain in the company's service in an advisory capacity.

H. V. Seth, East. Sales Agt., and John Allison, Chf. Engr., of the Pittsburgh Steel Foundry Co.

At the left: A. K. Baxter of Van Dorn & Dutton Co.

Left to right: T. H. Goodnow, Armour Car Lines; J. E. Libby, Swift & Co., and H. A. Stewart, Armour Car Lines.

J. F. Goodrich has been appointed assistant superintendent of the Arizona Eastern with office at Phoenix, Ariz.

J. J. Carey succeeds C. A. Gill as master mechanic of the Baltimore & Ohio Southwestern with office at Washington, Ind.

John B. Hammill has been appointed superintendent of the Boston & Albany, vice Philip Morrison, deceased. His office will be at Boston.

John C. Brennan has been appointed road foreman of engines of the Adirondack division of the New York Central & Hudson River, vice M. J. Graves, assigned to other duties. Mr. Brennan's office is at Tuffer Lake Jct., New York.

M. S. Smith and the Continental Trust Co. have been appointed receivers for the Denver, Laramie & Northwestern.

Peter McQuaid has been appointed master mechanic of the Prince Edward Island with office at Charlottetown, P. E. I.

J. E. Tierney succeeds A. J. Wade as master mechanic of the Louisiana & Arkansas at Stamps, Ark.

B. McBride has been appointed master mechanic of the Southern and the Augusta Southern with office at Charleston, S. C., succeeding W. B. Lipscom, resigned. H. B. Nabor succeeds Mr. McBride as general foreman of the Southern at Greensboro, N. C.

Among The Manufacturers

HOLLOW STAYBOLT IRON.

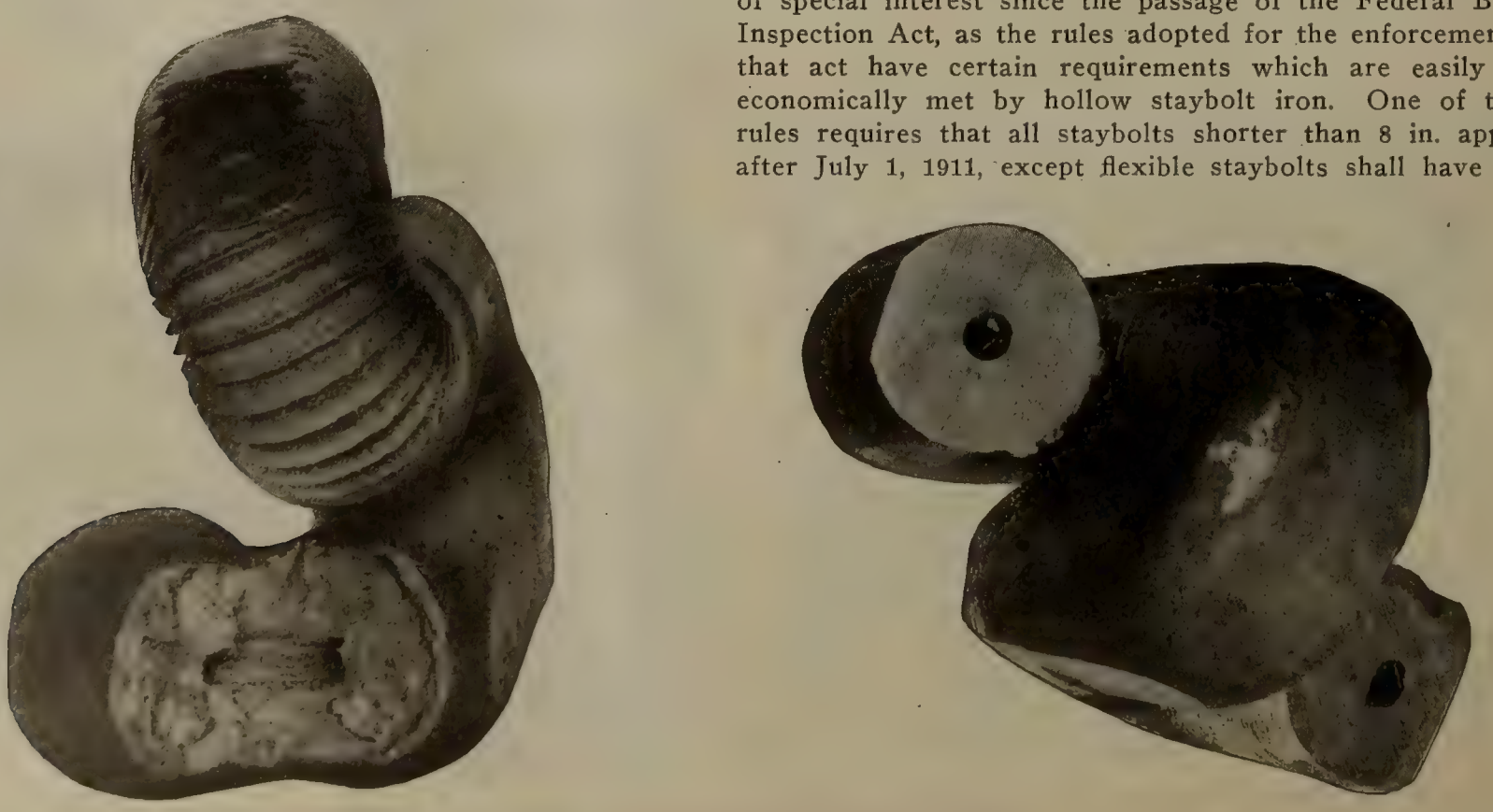
In the purchase of staybolt iron for locomotive fire boxes, it is desirable that it shall meet the various tests specified for strength and endurance under vibration, as well as the requirements of the Federal boiler inspection rules.

Falls Hollow staybolt iron has been frequently tested as to tensile strength requirements, and found to exceed them in elongation and reduction of area, which indicates unusual ductility, the valuable quality desired in staybolt iron, and which enables this particular iron to far exceed the requirements of the vibration test. The specifications now in general use are those adopted by the American Society for Testing Materials, and these require a tensile strength not lss than 48,000 lbs. per sq. in., not less than 28 per cent elongation in 8 in., and a reduction of area not less than 45 per cent. While Falls Hollow staybolt iron may sometimes not exceed the limit for ultimate strength, the elongation in 8 in. in such cases is always 32 to 35 per cent. The vibratory tests in the same specifications require that the test bar shall endure a minimum of 6,000 revolutions when a threaded specimen fixed at one end has the other end moved in a circular path while under a tensile load of 4,000 lbs. The circle described shall have a radius of $\frac{3}{32}$ at a point 8 in. from the fixed end of the specimen. Seven samples of Falls Hollow staybolt iron were tested under the above conditions at Purdue University, and the average number of revolutions required for rupture was 10,378. One sample endured over 13,000 revolutions and three over 10,000, while the lowest one required 8,339. The double bending test requires that the bar shall be closed in both directions without flaw. The illustrations show how well the Falls Hollow specimen has met this requirement, as well as the more severe test by bending after the specimen was threaded.

One of the illustrations represents a bar 1⅛ in. in diameter, bent cold flat on itself and retaining a smooth surface with no rupture. The extreme ductility of this iron is shown by the distance the molecules had to float without rupture in following the curve described in bending the bar.

The other illustration represents a bar 1⅛ in. in diameter nicked 1/16 in. deep one-half way around and bent flat on itself to produce rupture and show the fibrous structure of the iron and the stretch at the hollow portion. It also shows the standard V thread 12 per in. when bent flat on itself. Although each thread is the equivalent to the nick which ruptured the other end, no rupture is readily apparent, there being very minute ruptures at the base of every thread, thus demonstrating the complete uniformity of the fibrous structure.

The advantage of the hollow feature of this material is of special interest since the passage of the Federal Boiler Inspection Act, as the rules adopted for the enforcement of that act have certain requirements which are easily and economically met by hollow staybolt iron. One of these rules requires that all staybolts shorter than 8 in. applied after July 1, 1911, except flexible staybolts shall have tell-



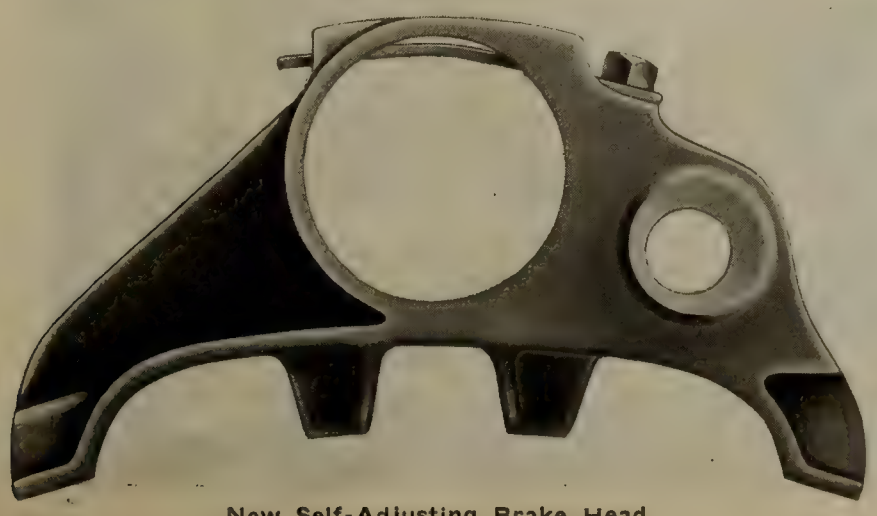
Falls Hollow Iron After Being Subjected to Tests.

tale holes 3/16 in. in diameter, not less than 1¼ in. deep in the outer end, and these holes must be kept open at all times. As is well known, the Falls Hollow staybolt iron has 3/16 in. holes clear through, so that the time and expense required for drilling every staybolt is avoided by the use of the hollow bolt. The use of the small hole in the staybolt is to detect fracture which almost always occurs near the outer sheet, and it is necessary, therefore, that the holes be kept open. A staybolt with the hole clear through will be kept open by the draught passing through it with every exhaust of the engine, and with fire or light inside the firebox it is easy to see at a glance that the hollow stays are open, while the hole in the solid bolt requires individual inspection in order to ascertain that the hole is open to the required depth. The hole in the hollow staybolt is kept clean to a large extent by the constant passage of air through it when the engine is working. The vacuum which is sufficient to draw air through a thick bed of hot coals on the grate will also cause an active current through the holes in hollow stays, and this is sufficient to clean out most of the dirt which stops up the drilled holes in other stays. This certainty of a clean hole in the hollow stay renders it a safe check on broken stays, and it is a valuable feature in view of the rigid requirements of the Federal boiler inspection rules, which state that no boiler shall be allowed to remain in service when there are two adjacent staybolts broken or plugged, nor when three or more broken or plugged stays are found in a circle of 4 ft. diameter, nor when more than five broken or plugged stays are found in the entire firebox.

The value of an admission of air in the firebox above the grate to prevent smoke and secure complete combustion has long been recognized; and hollow ferrules in the sides and ends of the firebox, with steam jets, were for many years regarded as efficient smoke preventers. Another method quite generally used was to drill ⅜ in. holes in many of the staybolts in the sides of the firebox for the purpose of securing an air supply above the fire, in order to obtain more complete combustion, and they were undoubtedly quite effective in producing that result. The hollow staybolt supplies an equal or greater amount of air to the hot gases and in a much better way. The jets are so finely divided that they have an opportunity to become highly heated soon after entering the box, and the air is then in proper condition to supply the needed oxygen for complete combustion of the gases.

In addition to these advantages there are others found with the hollow staybolt, due to the fact that the 3/16 in. hole is central in the bolt and the bending stresses do not reach a point where there is no material to resist them. The central hole of the hollow bolt is also an advantage in drilling out stays, for the large drill does not then reach the sheet and destroy the thread required for a tight stay.

This staybolt iron is made by the Fall Hollow Staybolt Co., Cuyahoga Falls, Ohio.



New Self-Adjusting Brake Head.

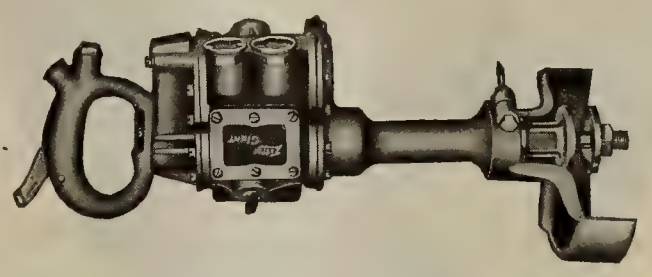
NEW BRAKE HEAD.

The Buffalo Brake Beam Co., New York, has produced a new self-adjusting brake head for high-speed passenger service. The adjusting feature of the head is simple and effective. Its construction is shown in the illustration. This brake head was shown at the Atlantic City convention this year for the first time.

IMPROVED LITTLE GIANT GRINDER.

The Chicago Pneumatic Tool Company has recently brought out an improved portable pneumatic grinder which has some unique features.

The grip handle is provided with a trigger which, when pressed down, opens the throttle and is held in that position until released by pressing a button at the side. The



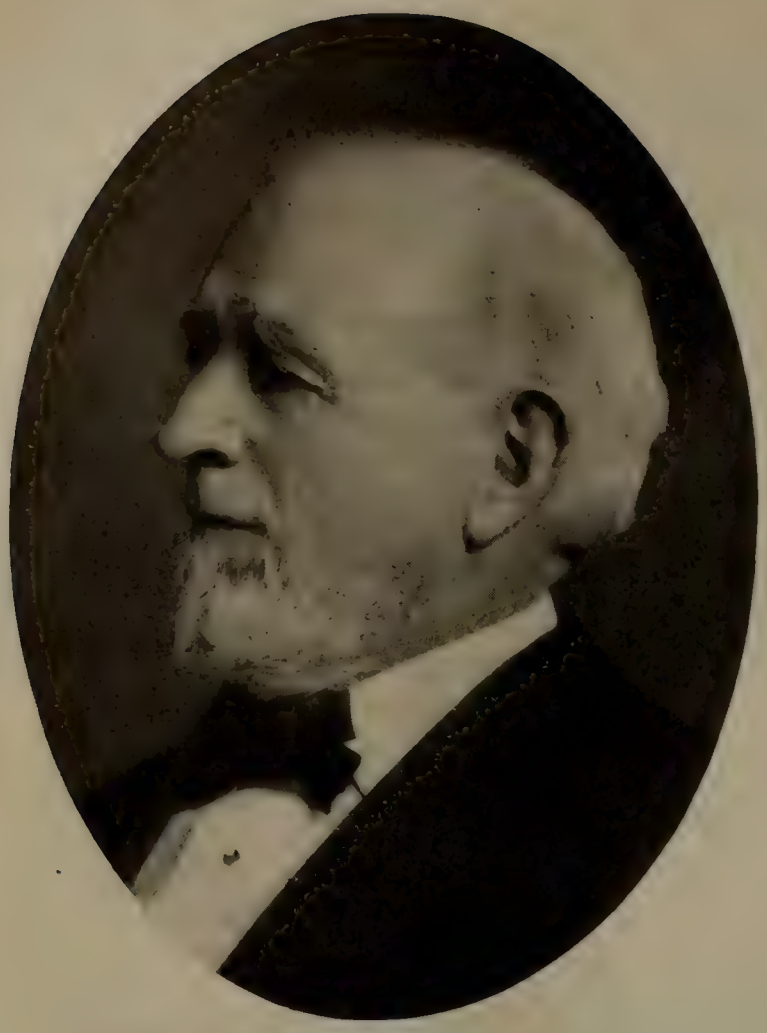
New Portable Grinder.

advantages of this arrangement are obvious as the operator is relieved of the strain of having to hold the trigger down with his thumb while with the thumb and fore-finger of the hand holding the machine he is able to start or stop it.

Another advantage lies in the manner in which the air hose is attached. Instead of entering at the side and thus adding dead weight to the machine, it is attached at the grip handle. This helps to balance the machine and keep the hose out of the operator's way.

After the throttle has been opened and the trigger set the operator is free to hold the grinder in any position most comfortable to him, which relieves him of some of the strain usually attendant on work of this character.

Stanwood Car Step.



Franklin Alter, Pres., American Tool Works Co.

Robt. S. Alter, Sec., American Tool Works Co.

The grinder is provided with a shield and its speed without load is 3,000 R.P.M. It weighs 20 pounds and will accommodate an 8x1-in. emery wheel.

STANWOOD STEEL CAR STEP.

The American Mason Safety Tread Co., Boston, Mass., and 50 Church street, New York City, has purchased from the Quincey, Manchester, Sargent Company, all patents, machinery, selling rights, etc., connected with the Stanwood steel car steps and treads.

The Stanwood step is well known, inasmuch as it has been extensively used by railways for a number of years. It has also been used largely as an automobile step and is specified by the U. S. Navy, where it is now in use on a number of battleships, cruisers and gunboats.

For those who are not familiar with the Stanwood step, a brief description of it may be of interest.

It is composed of a number of thin strips of high carbon steel bent or crimped so as to form corrugations, which when the strips are assembled produce a series of hexagonal openings. The portions of the strips which come in contact with each other are provided with bosses which interlock, thus making the step firm and rigid.

The frames are made of rolled steel of special section, provided on the inside with a ledge to carry the strips, and rounded on the outside to present a finished appearance. Rods pass through the frames and the steel strips, firmly tying them together and preventing them from sagging; and in addition straight strips of high carbon steel run lengthwise of the tread, forming an extra support.

Exhibit of the American Tool Works Co., Messrs. Alter, Hamersly, Cairns and Connors.

Toe guards are secured to the tie rods and are also riveted to the hangers.

The hangers are of pressed steel and are made in four styles of tops suitable for attachment to any style of car.

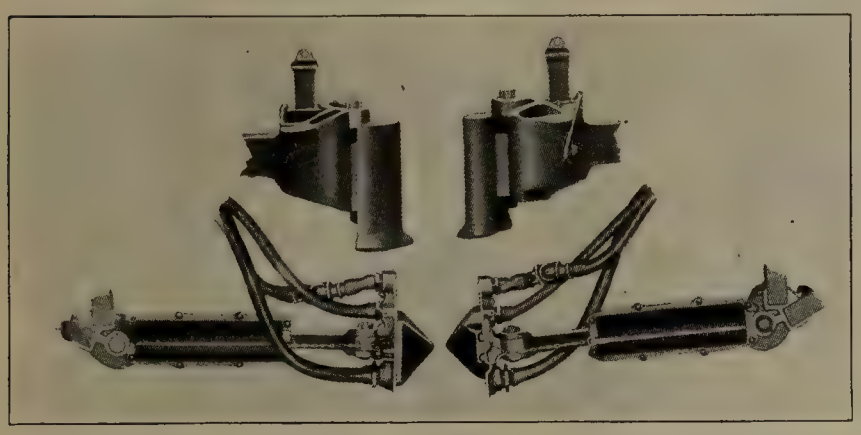
The surface of the tread presents a number of hexagonal openings, this forming a self-cleaning surface, and is raised three-eighths of an inch above the upper edge of the front frame, and by slightly beveling the first row of crimped strips a non-slipping edge is produced.

The entire construction is light, strong and serviceable.

The American Mason Safety Tread Company will manufacture this step at its works in Lowell, Mass., and will shortly be in a position to promptly fill all orders for standard shapes and sizes.

DURBIN TRAIN PIPE CONNECTOR.

The accompanying illustration shows an interesting device for connecting automatically the air, signal, and steam



Durbin Connector in Uncoupled Position.

pipes of passenger cars. The connector also automatically connects a telephone line for intercommunicating purposes between the cars of a train.

It is claimed for this connector that it is quickly interchangeable with present air and steam pipe connectors, that it will couple on the sharpest curves, that it will not leak, that it will not be damaged by the pulling out of a drawbar and that it overcomes the objectionable features of unsuccessful designs.

NEW OFFICERS, JACOBS-SHUPERT U. S. FIRE BOX COMPANY.

Gilbert H. Pearsall has been made a vice president of the Jacobs-Shupert U. S. Fire Box Co., and will be in charge of the Eastern sales office of that company, with headquarters at 30 Church street, New York.

Charles Brearley Moore has resigned as vice president of the American Arch Company, and has been elected a vice president of the Jacobs-Shupert U. S. Fire Box Co. He will be in charge of the Western sales department, with offices in the Railway Exchange Bldg., Chicago, Ill.

Mr. Pearsall will still retain his position as secretary of Joseph T. Ryerson & Son, with which concern he had been identified since May, 1901. He has been in general charge of the sales of the Ryerson company since January 1, 1905. Prior to his connection with the Ryerson company, he held positions in the traffic and transportation departments of several railway companies. He started his railway experience with the Erie in 1887, located at Owego, N. Y. From 1891 to 1897 he was connected with the Burlington; from

G. H. Pearsall, V. P., Jacobs-Shupert U. S. Firebox Co.

1897 to 1899 with the I. I. & I., and from 1899 to 1901 with the Lackawanna.

Mr. Moore was born in McComb, Ill., in 1874, and received his primary education in the public schools, graduating in 1891 from the Kewanee, Ill., High School. In 1895 he graduated from Lake Forest University and then attended the Northwestern University Law School, from which he graduated in 1898. The Columbia Boiler Co. was organized by him in 1900 for the purpose of manufacturing house-heating apparatus and boilers. In 1902, he organized the American Locomotive Equipment Co., and was general maanger and a director in that company until 1911, at which time he was elected its president. He assisted in the organization of the American Arch Co. in 1910, and was elected vice president and a director of that company, and in 1911 he also organized the Boss Nut Co., of which he is a director. Mr. Moore has invented and developed a number of locomotive devices, the best known of which are his locomotive brick arches, of which a great many are in general use. Mr. Moore's resignation as vice president of the American Arch Company became effective July 1st.

C. B. Moore, V. P., Jacobs-Shupert U. S. Firebox Co.

Recent Railway Mechanical Patents

BRAKE BEAM.

1,030,757—Henry Ziems, Jr., assignor to the Chicago Railway Equipment Co.

A brake beam comprising a compression member formed by cutting a longitudinal strip from the body of the member, bowing the strip out of its normal plane, and spreading the portions at opposite sides of the strip, a tension member, truss means extending between the tension member and the compression member, and means carried by the truss for holding the strip in its bowed position and for holding the portions spread apart.

CAR DOOR.

1,030,719—J. F. Conner, Oxford, Miss.

The combination with a car, of a rail, hinge hangers slidably engaging the rail, a door having portions of the hangers secured to the upper end thereof and also provided with a locking hasp, a two-part keeper comprising a movable member adapted to be engaged by the hasp, and a lower movable rail having guards to engage the lower end of the door and an arm with an angular end which is held closed by the movable member of the keeper.

CAR UNDERFRAME.

1,030,755—C. T. Westlake, assigner to Double Body Bolster Co., St. Louis, Mo.

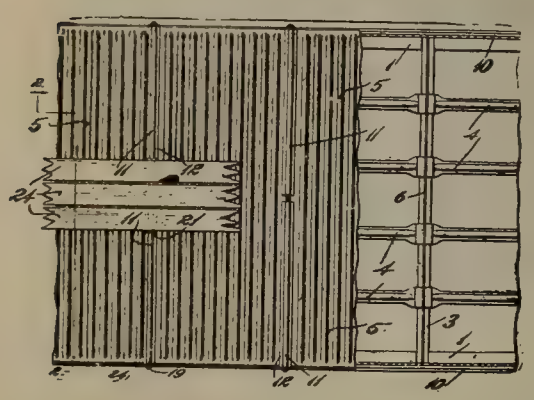
The combination with a car underframe, of a buffer beam integral with the underframe, in the top of which buffer beam is formed openings adapted to receive the lower portions of the car end posts, and the rear wall of which buffer beam is recessed at the rear of the openings to accommodate the rear flanges of the car end posts.

METAL CAR ROOF.

1,030,603—W. P. Murphy, Chicago, Ill.

In a car roof, a substructure comprising metal carlines extending from eaves to eaves and having vertical webs, purlins extending between the carlines and rigidly secured thereto, the tops of the purlins being at a lower elevation than the tops of the carlines, metal roof sheets arranged on the purlins and having marginal flanges adjacent the vertical webs of the carlines and spaced therefrom, the roof sheets extending from eaves to eaves and being provided with terminal flanges overlying the eaves, and seam caps extending from ridge to eaves and covering the vertical webs of the carlines and marginal flanges of the roof sheets and spaced from

1,030,603



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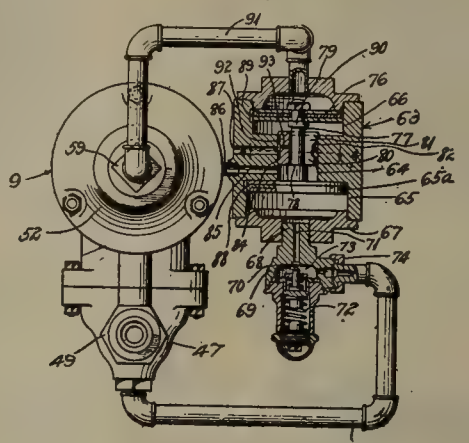

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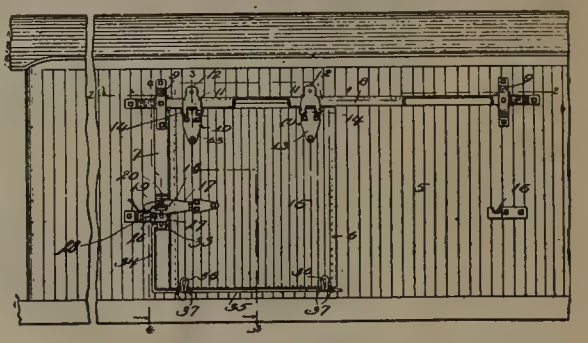

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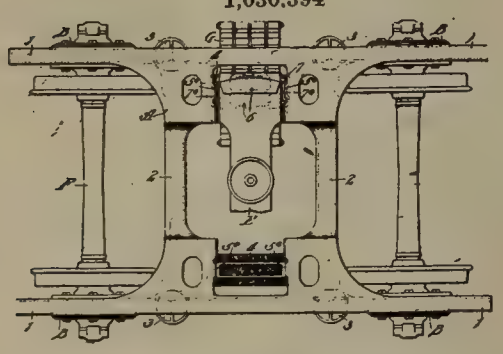

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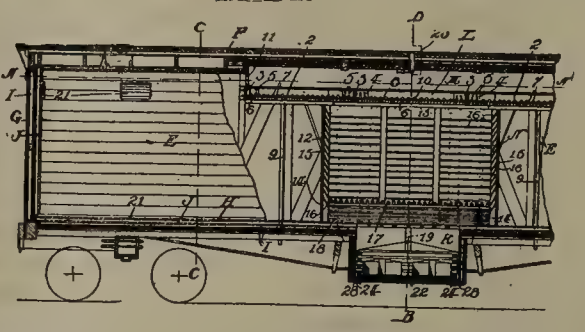

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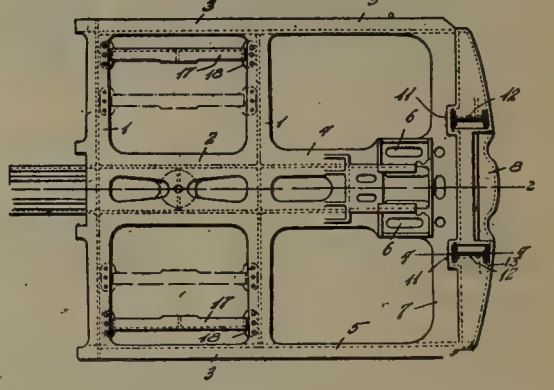


the latter, the seam caps being loosely secured at the ridge and eaves.

CAR TRUCK.

1,030,394—H. E. Doerr, assignor to Scullin Gallagher Iron & Steel Co., St. Louis.

A four-wheel truck having a frame comprising two wheel-pieces and two single transoms integrally connected together, the end portions of the transoms being relatively wider than the intermediate portions of same, a bolster arranged between the transoms and guided by the relatively wide end portions of same, spring seat members integrally connected to the end portions of the transoms and each consisting of a horizontally disposed part and two vertically disposed side parts, springs mounted on the horizontally disposed parts of the spring seat members, roller devices consisting of rollers and roller seat members arranged between the springs and bolster, and ribs on the vertically disposed side parts of the spring seat members which guide the roller seat members of the roller devices.

BRAKE SHOE ADJUSTER.

1,030,150—J. S. Ashworth, Cuyahoga Falls, O.

In a brake shoe adjuster, a support, a member movable relatively to the support, a lever pivoted at one end to the support, means connecting the member and the other end of the lever, a brake shoe mounted on the lever, a rack, a pawl on the member for engaging the rack and preventing the movement of the rack in the direction of the brake shoe, an operating lever pivoted at one end to the rack, and a second brake shoe mounted on the operating lever.

PLATFORM BUFFER FOR PASSENGER CARS.

1,029,938—T. L. McKeen, Easton, Pa.

The combination with a platform buffer head, and a platform end sill having a buffer chamber therein, of a wedge which is moved inwardly in the buffer chamber by the buffer head, friction blocks which are arranged on opposite sides of the wedge and are movable inwardly with the wedge and also laterally in the buffer chamber, bowed leaf springs arranged in the buffer chamber lengthwise relative to the movement of the buffer head at opposite sides of the friction blocks for opposing the lateral movement of the friction blocks, a coil spring which projects into the space between the first mentioned springs in the buffer chamber and which holds the friction blocks against the wedge and permits the inward movement of the friction blocks, means for limiting the inward movement of the friction blocks, and means for holding the springs from movement in the direction of movement of the wedge.

TRAIN BRAKE.

1,030,565.—J. W. Kelker, Los Angeles, Cal.

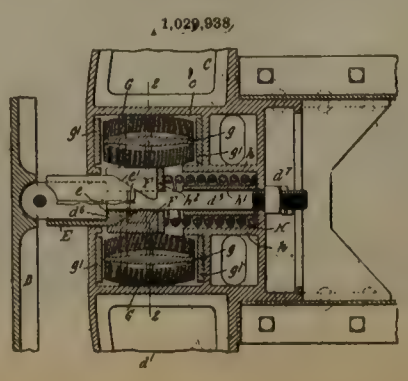
1. A pneumatic brake mechanism, comprising means for directing the flow of air from the train pipe to the brake cylinder through the usual brake controlling valve mechanism, means for controlling the flow of air to brake cylinders, means for driecting some of the air into the auxiliary reservoirs, the reduction of pressure in the tran pipe due to filling the brake cylinders and charging the auxiliary reservoirs, producing sufficient excess of pressure in the auxiliary reservoirs to catch and hold the air pressure in the brake cylinders until it is desired to release the same.

REFRIGERATOR CAR.

1,030,524.—C. A. Moore, Assignor to Moore Patent Car Co., St. Paul, Minn.

3. A refrigerator car, comprising, in combination, a car body having a roof substantially straight throughout its length and a provision chamber extending entirely from end to end thereof, an ice bunker immediately below the roof of the car having both ends remote from the ends of the car and extending the entire inside width of the car body and provided with upright ends opening directly into the top of the provision chamber for the free circulation of air, a hatchway in the roof of the car over the ice bunker, and a second ice bunker having a median position in the provision chamber below the first bunker and communicating therewith through an aperture in the floor thereof.

1,029,938.



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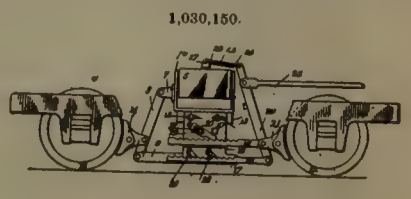

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Published at the World's Greatest Railway Center
Established 1878

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TERMINAL ELECTRIFICATION.

It is quite possible that the next extensive electrification project will intimately concern one of Chicago's terminals. One of the difficulties seems to be that all-powerful Public Opinion has attacked the most difficult problem first and has been constantly directing its shafts at the long suffering Illinois Central simply because that road occupies the front yard, as it were. This fact more than anything else has delayed Chicago's first electrification experiment. The Illinois Central smokes up the lake front to a certain extent. Nobody denies that fact. But Chicago has worse smoke problems. As far as the congested district is concerned, a wind from any direction except the east blows the smoke away from the city. Nearly all of the other important railways pass through the congested districts and it matters not what the direction of the wind the smoke cannot be avoided. From an engineer's standpoint, the Illinois Central presents the most difficult problem for electrification. Its semi-subterranean "bottle neck" through Grant Park, its extensive freight yard at the north end, its heavy suburban traffic sharing the use of the "bottle neck" with the freight, the complex arrangement of tracks at the passenger terminal, all offer obstacles unsurmounted in electrification projects previously consummated.

The people of Chicago allowed the Chicago & North-Western to build one of the finest passenger terminals in the world and to arrange it for steam operation without much more than a mere suggestion here and there that it be electrified at the start. This is probably due to the general satisfaction over the beauty and convenience of the station itself. Yet the North-Western is one of the offenders in the production of smoke. Its suburban traffic is nearly as heavy as is the Illinois Central's and it maintains a roundhouse which can never be anything but a nuisance while it shelters steam locomotives. This is more on account of its location under the viaduct of one of the city's mainly traveled streets, than anything else. The North-Western offers none of the physical obstacles to electrification which would have to be surmounted on the Illinois Central. Its passenger and freight terminal traffic are practically separated. Its roomy right of way and widespread track centers will allow the application of any system which might be chosen. In short, with respect to the North-Western, we find that not only would there be more genuine benefit for the city in the event of its electrification, but its terminals offer the last obstacles to electrification. With the assistance of the experience gained by the consummation of this comparatively simple project, it is probable that the more difficult ones could be attacked with more confidence.

THE INTERNAL COMBUSTION LOCOMOTIVE.

In an address before the committee of the Chicago Association of Commerce which is now studying the railway terminal problem with a view to the abatement of locomotive smoke, W. R. McKeen, Jr., has suggested the internal combustion locomotive. This address is abstracted on another page of this issue. His treatment of the subject and his answers to the questions of his auditors show him possessed of considerable confidence in this solution of some railway motive power problems.

The success of the gasoline driven motor car which Mr.

McKeen has developed forms the basis for his recommendations of an extension of the principles involved. In the motor cars of McKeen design the power is transmitted direct to the driving axle by means of a chain, a reduction gear being used for temporary purposes and a clutch interposed. Mr. McKeen, however, admits the necessity for the use of a transmission in a locomotive which will allow the engine to work at a practically constant speed while giving any desired speed to the driven axle. With reference to this problem he suggests the oil transmission principle which is new in this application. He describes no method for this adaptation, and it is possible that the constitution of the first large locomotive may rest upon the development of this feature.

Outside of the transmission it seems logical to assume that the introduction of large, practical internal combustion locomotives is simply dependent upon the adaptation of principles which have been accepted in other applications. In the discussion of the subject, Mr. McKeen took the position that a considerable economy of operation is to be expected from the use of the internal combustion motor. This is due partly to the fact that, by means of a flexible transmission, the assistance of gravity can be used to the fullest extent in drifting with the engine out of service. The consumption of fuel ceases immediately when the motor is cut out and stopped on down grades or preliminary to a stop, whereas, with the steam locomotive, the consumption of fuel continues, of course, to a more or less extent from terminal to terminal. With reference to comparative fuel cost Mr. McKeen made the somewhat surprising statement that until gasoline reaches a cost of twenty cents per gallon it can be used economically as compared with steam production. He suggests that when eventually this limit may have been reached, the internal combustion engines can be arranged to use alcohol, kerosene, crude oil, and eventually producer gas generated from cheap coal.

WILPEN, CORNING AND WESTERN SPRINGS.

Three serious railway collisions occurred during the month of July. As usual a renewed general discussion of railway equipment, construction and safety devices has been provoked. This discussion, which results in agitation for legislation, as far as the public press is concerned, deals with many phases of the equipment regardless of any connection or absence of connection with the causes of the accidents in question. The circumstances surrounding these accidents are fairly well known, but owing to certain garbled reports in the daily press it is thought best to give them briefly here.

At Wilpen, Pa., on the Ligonier Valley, a collision between a double-headed freight train and a passenger train consisting of one car ahead of the engine, occurred July 5. The circumstances surrounding this accident were such that there can be little benefit resulting from a study thereof. The Interstate Commerce Commission's report shows that on this branch no block signals of any kind were in use; that no train orders of record are used, the movement of trains being governed by the dispatcher in verbally given orders to the conductor; and that the road has no printed rules of any kind for the guidance of train men.

At Corning, N. Y., on the Delaware, Lackawanna & Western, a rear-end collision of passenger trains occurred July 4. This accident was by far the most serious in over two years, 39 passengers being instantly killed. Westbound passenger train, No. 9, made up of ten cars of both steel and wood, was blocked by a freight ahead. While standing with the protection of both home and distant block signals and the flagman, it was struck by express train No. 11. The rear car of No. 9 was built of wood, while the one ahead of it was of steel. The wooden car was completely destroyed.

At Western Springs, on the Chicago, Burlington & Quincy, a rear-end collision between an eastbound passenger train and an eastbound mail train occurred on July 14. Eastbound passenger train No. 2 was stopped by the manual block system signal at the tower at Western Springs. The engineer, however, on account of foggy weather, over-ran the signal by over a thousand feet. The operator then cleared the block west for the purpose of advancing the following mail train, No. 8, the length of the block to Western Springs. No. 8 is the fastest train on the road, and, just as had No. 2, and indeed, No. 4 earlier still, its engineer over-ran the signal, passing it at nearly seventy miles per hour. He discovered his mistake at the tower and attempted to stop, with the result that the rear end of No. 2 was struck at a speed of less than thirty miles per hour. The actions of No. 2's flagman are not well defined, but it appears that he placed two torpedoes too close in to be of any assistance in warning the engineer. No. 2 was made up of wooden cars, one of which was completely destroyed, thirteen persons being killed.

The Wilpen collision was due purely and simply to careless methods of operation. The conductor of the passenger train is held guilty of neglect in allowing his train to proceed beyond a meeting point said to have been designated by the dispatcher. As there is no record of such an order having been given him, however, it becomes a question of veracity between conductor and dispatcher. Conditions invited accidents and until there is improvement in conditions on the Ligonier Valley, accidents of this nature are to be expected.

In the case of the Corning collision, agitators for the automatic stop could ask for no better ammunition than that furnished by the conduct of the engineer of No. 11 in running past two signals and a flagman. There was, however, no particular reason for taking special precaution at the point of this collision in laying out the signaling system. Automatic stops, if consistently located, would have had to be placed at each block signal if this collision was to have been prevented by their use. The flagman of No. 9 was unable to attract the attention of the engineer of No. 11, although he was passed by the latter at a point two thousand feet to the rear of his train, and in spite of the fact that he had used a fuse. This fact is partially accounted for in two ways. The morning was somewhat foggy and an injector on the engine of No. 11 had been causing trou-

ble. In the inquest, the flagman testified that he used no torpedoes and stated as the reason that the signal officers objected to their use near automatic signals. This is a somewhat unusual excuse and the probabilities are that it is based on some trouble with circuits caused by the metal of the exploded torpedoes and the resulting kicks of some maintainer. It did not develop that any instructions have ever been officially issued limiting the use of torpedoes on automatically protected tracks. The whole subject is interesting, however, in its relation to the accident and responsibility of the signal department. It was found that upon this occasion the signals were in perfect condition and the blame falls upon the engineer of No. 11. The design of the standard Lackawanna passenger engine is such that there can be practically no monitoring of the engineer by the fireman.

The engineer's cab is located on the barrel of the boiler ahead of the firebox. In order to speak to him while the train is running at a high rate of speed, it is necessary for the fireman to walk out on the running board to the rear door of the forward cab. In the conversation the engineer must lean in from the window and turn around. The testimony in this case developed the fact that the signals and flagman were passed unseen for this reason ,the bucking injector being the subject of the conversation. The arrangement of cars hauled in No. 9 has been condemned by authorities since the advent of the steel car. It is true that there is a difference of opinion as to the location of the heavier steel cars in a mixed train, but it has never been considered good practice to place a steel car between wooden ones, as was done in this case. The best practice in passenger train make-up, is, of course, to use only all wood or all steel cars. It is regrettable that this is not always possible. There are thousands of wooden passenger cars in the country which must be used, but whereas heretofore one or two steel cars have been made up in a train of wooden cars on account of the scarcity of steel equipment, now we are fast approaching a state of affairs when it will be only occasionally necessary to place a wooden car in a train otherwise all steel.

At Western Springs the question of the automatic stop again comes into prominence. Like that at Corning, however, the accident took place on a straight and level track. There was no particularly dangerous physical feature which called for special protection at either point. Automatic stops are conceded to be of value at dangerous crossings and the like, and, no doubt, the future will see many applications of this nature. The manual block system of the Burlington is said to have been termed by its signal engineer, Mr. Latimer, the safest in the world. The fact that this road has commenced, since this accident, to install distant signals in connection with the tower boards, would seem to indicate that there was still room for improvement. It is, we believe, generally conceded among authorities that the Western Springs accident would have been prevented by a distant signal. This, in spite of the fact, as pointed out, that the distant signal did not prevent the Corning collision. On the morning of the Burlington's accident, three engineers in succession over-ran the tower board at Western Springs. Yet in each case the signal was noted and the stop made. This is pretty good evidence that the fault lies with the system and not with the men. The cars hauled in No. 2 were of wood. The destruction of the rear car was total, yet as demonstrated by the Odessa wreck, the steel car would have offered little greater protection for its passengers in an accident of this kind.

LOCOMOTIVE MANUFACTURE.

Editor, Railway Master Mechanic:—I had the pleasure of reading the editorial in the June issue of the *Railway Master Mechanic* on the subject of "Locomotive Manufacture," when it originally appeared and have re-read it with renewed interest. While I endorse every word that it contains it appears to me that you have covered the subject so thoroughly that there is very little, if any, room left for comment.

The building of locomotives in this company's principal shops at Louisville has been practiced more or less for over forty years, commencing as far as our records show, as early as 1870 under the supervision of the celebrated Thatcher Perkins, superintendent of machinery, one of the foremost mechanics of his day; in fact, often spoken of as a mechanic in advance of his time. This policy has been pursued ever since to the extent that it did not interfere with the maintenance of the equipment in service.

For numerous reasons we believe that it is good policy to have a shop suitably equipped for the manufacture as well as the repairs to locomotives. We find it particularly advantageous in the matter of retaining a well organized and trained force of mechanics with which to meet the maximum maintenance requirements during and after heavy movements of passengers and freight, rather than make occasional reductions in the force, which frequently results in disorganization. Our employes, from the master mechanic down, take a lively interest in turning out a creditable piece of new work which, I am satisfied, has its effect on the quality of maintenance repairs.

(Signed) C. F. Giles, Supt. of Machinery,
Louisville & Nashville R. R.

Editor Railway Master Mechanic:

Referring to the editorial on page 211 of the June issue of the *Railway Master Mechanic*, in many ways I agree with what you say, but in some points I prefer to differ from you.

While, no doubt, men engaged in operating railway shops are entirely competent to construct new locomotives, there is no question that to do so economically would necessitate a more extensive and systematic supervision than is necessary for straight repair work. No doubt the system thus involved would be a good thing for the shop, but at the same time it is not economical unless the work is sufficient to justify its being occupied.

The tools used in locomotive building can, no doubt, be advantageously employed in repair work, except in the case of special tools which cannot be sufficiently employed in repair work to justify their installation, but could be used to a sufficient extent in building locomotives to expect them to assist in reducing the cost of the locomotive repair output. All the machine tools employed in locomotive building are in addition to those used for turning out a given number of repairs and must be regarded as an additional investment.

The size of shop necessary to accommodate these tools, blacksmith shop foundry and other equipment required to construct new locomotives is all, practically speaking, in addition to that required for a repair output. It is therefore entirely unreasonable for a road to consider that because it can turn out locomotives at a cost less than it can obtain them from the builders that it can neglect the additional investment. There are many cases where locomotives have

been turned out without adding anything like a sufficient amount to the actual cost of material and applied labor to cover the necessary expenses in connection with the operation of the plant, to say nothing of the interest and depreciation on the investment involved. Such items as repairs to tools and machinery, maintenance of buildings, supervision, drawing office expenses and a number of charges which have to be taken care of by every concern, are ignored in the case of railroads building their own locomotives.

I do not believe there is a railroad shop in the country which constructs a new locomotive with as low a net cost of labor as any of the large building concerns do. It is true that even if expenses are evenly pro-rated, they may show a saving which is part of the profit obtained by the locomotive builder. This profit is, however, expended by the builder in keeping his plant up to date or spending dividends on the moneys invested in his plants so that when all is said and done the saving on the part of the railway company is comparatively small if looked at from a broad point of view.

You have also raised the point of standards. I do not see why standards cannot be just as well obtained when locomotives are purchased as when they are constructed by a road itself. The question of design is not affected by purchasing or building, but when engines are arranged for without regard to maintaining a standard class of power, it is therefore no wonder that some roads get so many diversities of equipment. The standardization obtained in England is not so much on account of a road building its own locomotives, but on account of the large amount of responsibility placed on the locomotive department in the designing of its power and the permanence of the locomotive policy on the roads not disturbed with each new general manager, but allowed to take its course and progress in a systematic way. I do not think you wish to hold up English roads to American, but there are some American roads which have followed similar methods and they have obtained standardization.

(Signed) H. H. Vaughan.
Assistant to the Vice President, Canadian Pacific Ry.

Editor Railway Master Mechanic:

The editorial in the June number of the *Railway Master Mechanic* brings up several very interesting points.

There can be no question that were the average large railway shop properly equipped, there would be considerable economy in building new power in dull times, to keep the organization together, as well as to get the use of the equipment which would otherwise be idle at this time. Unfortunately the average railway management does not take this view of the situation, and whenever there is a necessity for slack time on the railway, expenses must immediately be decreased in proportion; so that instead of taking advantage of the opportunity, the average management uses it in the opposite direction as a lever to cut down expenses in every direction. Looking at the whole matter broadly, the whole question should be premised by the size of the road and the number of engines which they will require for renewals and replacement. If a railway company having a large locomotive plant will require, on the average, about 30 engines per year, there is considerably economy in their purchasing the necessary shop equipment and arranging to build that number of engines, putting the new work in at such time as will not interfere with the regular repair work.

In a general way, the first point where the pinch is felt when engines are being built, will be in the boiler shop. The average railroad shop does not have sufficient room in this department to take care of new boiler work satisfactorily, unless special provision has been made.

Along with the boiler shop of sufficient size, there are a number of special tools which are not justified in the ordinary railroad shop, but which become essential if engines are to be built economically. Among these are a hydraulic riveting tower, automatic axle keyseater, forging and flanging presses, heavy frame planers and heavy double head frame slotters. There are also a number of other special tools, such as heavy hammers, forging machines, etc., which should be included. All of this equipment, however, not only comes in for the building of locomotives, but is extremely handy at times for general repair work, although not under general repair conditions being authorized or warranted without sufficient work to keep them busier than they would be on this line of work alone.

One of the railways in the East, at the request of the president, took up this question and went into it thoroughly. They were authorized to place the additional equipment necessary and enlarge the boiler department sufficiently to build their own engines. A very careful analysis of all expenses incident to the building of the engines, counting in all overhead charges, etc., showed a very creditable profit to the railroad for carrying out this policy. On the other hand, it should be borne in mind that only a large railroad, with a large shop, and one which is willing to make a considerable expenditure for equipment, can do this successfully. However, when once done, it becomes a very good investment. A class of power is produced that is more nearly standard than can be purchased from outside builders, and in general the little details of workmanship are better, as there is closer supervision by the railway officers of the details.

As to the ability of the shops to handle this work as far as supervision is concerned, there is no question whatever. I have seen it done very successfully without in any way increasing the amount of supervision or having any special men brought in to look after the new work. It is simply a question of a greater volume of business handled in the plant and a greater number of mechanical employes.

The performance of the engines built in this manner were in every way satisfactory, requiring a minimum amount of breaking in before being ready for service, and giving general satisfaction from the time they were built. If it were possible to have the use of the shop for building engines in dull times, when otherwise the force would be cut down, there is no question that a very much better organization could be maintained by using the shop on nearly a uniform basis throughout the year, in dull times building new power, and when the road is busy, doing general repair work. Unquestionably our managements will see the wisdom of this policy and some day will be willing to authorize it. Unfortunately this is not general at the present time.

(Signed) S. M. P.*

Editor Railway Master Mechanic:

I have read with considerable interest your editorial on "Locomotive Manufacture" in the June issue. I think you have made an argument which can scarcely be refuted. Until our road authorized the building of its first order of locomotives in our general shops, we were seriously handicapped in the lack of certain tools, particularly in the blacksmith shop. On the strength of immediate necessity, due to the starting of work on the new locomotives, we were able to secure an appropriation for the purchase of four heavy tools.

These machines have been in service for several years and have reduced the expense of certain repair items by more than half. They are almost never idle, whether the work be repairs or new construction. Since that time the equipment of the shop has been increased and modernized with a view of reducing the cost of engine repairs, and also with a view of furnishing all of the heavy machines necessary to new construction. It was found that in each case

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*Letters and original manuscript are on file in the offices of the *Railway Master Mechanic*.—Ed.

the requirements for machines for both purposes were identical.

As far as the *Railway Master Mechanic* is concerned it seems to me that the publication of these facts might bring down upon it the wrath of the locomotive manufacturers. The indication is that you do not fear such consequences. My interest in the paper which dates back a great many years prompts this thought. (Signed) S. M. P.

[Editor's Note.—With reference to the last paragraph of the above letter, we believe that our correspondent's impression as to patronage is much more common than the facts warrant. No doubt the editorial policies of some papers are elastic enough to allow of reshapement under the dictation of influential persons, advertisers or prospective advertisers. It is probable that in the ramifications of financial interest, the dictation of editorial policies might be traced to surprising sources, but the evidence is only in the most exaggerated cases, sufficient to be called conclusive. The advertising pages of the *Railway Master Mechanic* are not open for the business of any concern which places its advertising with the understanding that on account of such consideration, the concern in question is to be given a voice in the editorial policy. On the other hand we believe that no other paper in the railway field holds itself so ready to lend the use of its reading space for the purpose of discussion of meritorious improvements or devices without obligation on the part of those who may reap benefit thereby.]

A SAFETY ORGANIZATION has been established on the Denver & Rio Grande R. R., composed of a central safety committee, a division safety committee and a shop safety committee. The organization and purpose is similar to that of other roads which have adopted the "safety first" idea. The 1912 budget of this road, which has been made public by vice-president Brown, shows that about $6,000,000 will be expended, $2,500,000 of which will be spent for equipment and the remainder for double track and improvement of terminal facilities.

ON THE 27th DAY of August the Traveling Engineers' Association will meet in convention in Chicago. Its program includes too little discussion of the operation of the power used on electrified lines. The committee on subjects for next year has already tentatively reached its decision on a program. It is to be sincerely hoped that more attention will be given to the electric locomotive. Without doubt members will be called upon in increasing numbers to direct the handling of electricity as a motive power, year by year. They must not be unprepared.

TWO MEN were walking along the street. One of them was evidently to receive a promotion and was overheard saying to his companion: "He would be my logical successor if he could only control himself." Who the "he" in question was, is not known, but that remark could be applied to many situations where the question of choosing a man for a position, comes up. For every position, the question of choosing a successor will eventually arise, perhaps tomorrow, perhaps in five or ten years. Usually there is one man who it is generally expected should be the successor. And how often it occurs that he is side-tracked because he could not control himself, because he let passion and prejudice decrease his efficiency to such an extent that promotion had to stop. The big men in railroading, as well as in other fields, today have their hands always on the throttle and are not running any signals. And what's more, they know when to "give her air."

The Traveling Engineer

By Berton Braley.

Copyright 1912, W. E. Magraw.

He served his time as an engine man
  In the overalls of blue,
And many a thousand miles he ran
  Till he learned his job—all through!
And when, behind his massive brow,
  His knowledge was plain and clear,
He started showing the others how,
  The Traveling Engineer!

For he still can sit on his old time seat
  In the cab, as he sat of yore,
And keep her steaming smooth and sweet
  While the blazing fire-tubes roar,
He can teach the fireman to save his coal,
  And the engine crew gives ear
For he is surely a "wise old soul,"
  The Traveling Engineer.

Efficiency Man for the Motive Power,
  He takes no half-way views,
But day by day and hour by hour
  He's training the engine crews;
He didn't learn from the book-room shelf
  But steadily, year by year,
Grew wise by doing the thing himself
  The Traveling Engineer!

You might make a bluff with the president
  And maybe he wouldn't call,
And the "super," perhaps, might be content
  If you gave him a clever stall;
But none of that monkey-business goes,
  With the boss of the running gear,
When it comes to Engines—he knows, HE KNOWS!—
  The Traveling Engineer!

By day his work—and by night his dream
  Is to cut down the cost per mile,
To find new methods of making steam
  In cheaper and better style;
RESULTS are his goal and his daily code
  And the vision he holds most dear,
Is perfect Power on a Perfect Road—
  The Traveling Engineer!

Officers of the Traveling Engineers' Association

W. C. Hayes, President.

W. C. Hayes entered railway service in 1869 with what is now a part of the Pere Marquette R. R., going to the Lake Shore & Michigan Southern in 1871 as a locomotive fireman, and was promoted to the position of locomotive engineer in September, 1877. He went from there to the Minneapolis & St. Louis in 1879 and remained in its employ until 1899, serving as a locomotive engineer on freight and passenger engines during a period of twenty years. He then went to the Baltimore & Ohio as locomotive superintendent in charge of the operation of locomotives for the entire system; then to the Erie in 1901 to a similar position, serving respectively with the Erie in a position of general road foreman of engines, assistant mechanical superintendent, superintendent of the employment bureau, division superintendent, and for the past four years as superintendent of locomotive operation.

W. C. Hayes.

W. H. Corbett, 1st Vice-President.

W. H. Corbett began his railway career on the Central of Vermont as newsboy. He commenced as fireman on the Michigan Central in 1879, was promoted to locomotive engineer in 1882. He served as a freight and passenger engineer until 1903 when he was promoted to road foreman of engines, filling that position until June 1st, 1912, when he was promoted to master mechanic of the western division, with headquarters at Michigan City, Ind. This measures a service of thirty-three years for the Michigan Central.

W. H. Corbett.

F. P. Roesch, 2nd Vice-President.

F. P. Roesch entered railway service on the Chicago, Rock Island & Pacific as machinist apprentice at Trenton, Mo. After completing his apprenticeship he went west, working as machinist at Denver, Colo., Salt Lake City, Utah, and Sacramento, Calif. He was appointed foreman at Winslow, Ariz., on the Atlantic & Pacific, now the Atchison, Topeka & Santa Fe Ry. From there he traveled over the country working in various places. He finally took the position of general foreman with the Florida Railway & Navigation Co., Fernandino, Fla. Resigning this position, he went firing a locomotive, being afterward promoted to locomotive engineer. He returned west in the spring of 1886 to take the position of general foreman, D. & N. O. Ry., now the Colorado & Southern, at Denver. In March, 1899, he was appointed general traveling engineer. He resigned in February, 1903, to accept a position as master mechanic of the Chicago & Alton, at Slater, Mo. After two years he resigned to accept a position as general manager, Hicks Locomotive & Car Works, Chicago, Ill. He resigned, after two years, to take the position of master mechanic of the Southern Ry., Birmingham, Ala. Two years later he accepted his present position, namely, master mechanic of the El Paso & Southwestern at Douglas, Ariz.

F. P. Roesch.

John McManamy, 3rd Vice-President.

John McManamy entered the service of the Chicago & West Michigan R. R. in the capacity of locomotive fireman on September 1st, 1891, and was promoted to locomotive engineer on March 2nd, 1899. After the Chicago & West Michigan R. R. was merged into the Pere Marquette R. R., he was appointed traveling fireman on February 24th, 1901, with headquarters at Saginaw, Mich., and on April 1st, 1903, was appointed road foreman of engines of the Grand Rapids district, with headquarters at Grand Rapids, Michigan. When the Pere Marquette R. R. acquired control of the Lake Erie

John McManamy.

& Detroit River R. R. in 1904, Mr. McManamy was appointed assistant master mechanic with headquarters at St. Thomas, Ont. During his term of service in that capacity the tracks of the Chicago division were extended to Porter, Ind., and the Pere Marquette began operating trains into Chicago. This made a remarkable increase in the traffic on Chicago division, and the Grand Rapids district was rapidly developing into the most important division on the Pere Marquette R. R., and on July 15th, 1906, he was transferred to the Grand Rapids district in the capacity of road foreman of engines, with headquarters at Grand Rapids, Michigan, where he continued to serve in that capacity until August 28th, 1911, when he received an appointment of district inspector of locomotive boilers of the Interstate Commerce Commission, with headquarters at Grand Rapids, Michigan.

Clinton B. Conger, Treasurer.

Clinton B. Conger entered railway service as a locomotive fireman in April, 1870, and was promoted to engineer on the Port Huron & Lake Michigan R. R., now a part of the Grand Trunk Ry., between Port Huron and Chicago. From September, 1880, to September, 1882, he was a locomotive foreman at Valparaiso, Ind., and on Nov. 1st, 1887, was appointed mechanical engineer for the Commissioner of Railroads of Michigan. March 1st, 1891, he entered the service of the Chicago & West Michigan Ry., and the Detroit, Lansing & Northern R. R., now consolidated into the Pere Marquette R. R., as road foreman of engines and superintendent of air brakes. January 1st, 1899, he was associate editor of *Railway and Locomotive Engineering*, shortly afterward joining the Railway Department of the International Correspondence Schools as superintendent of instruction. April 29th he joined the sales force of Wm. Sellers & Co., Inc., in the Injector Department, where he is now employed. He has been a member of the Brotherhood of Locomotive Engineers since 1872. When the Traveling Engineers' Association was formed in 1893, Mr. Conger was its president and was re-elected for five consecutive terms, and since 1904 has held the office of treasurer.

Clinton B. Conger.

W. O. Thompson, Secretary.

W. O. Thompson was born in Michigan in 1862. He commenced railroad work in 1880 on the Fort Wayne, Jackson & Saginaw Ry. as a section hand. After one year he became a machinist-apprentice, then successively locomotive fireman, engineer, road foreman of engines, master mechanic, superintendent of motive power, and for the past five years he has been district master car builder; all of the time served has been with the New York Central Lines.

W. O. Thompson.

The South Carolina Western has opened the extension of its Sumpter division to Bishopville, S. C., 16 miles from Hartsville.

The Texas, Gulf & Northern has completed negotiations for building this line from Tucumcari, N. Mex., crossing the Texas & Pacific at Midland, Tex., southeasterly to San Antonio, about 600 miles. Work has already been begun at Midland on the permanent location. A contract has been entered between the railway company and the residents of Midland, which requires that construction work shall be begun within 60 days. Midland is to be a division point, and it is the present intention to locate the headquarters and principal shops at that place. The officers are J. A. Underwood, president; W. N. Sadler, vice-president, Amarillo, Tex., and M. C. Lemaster, secretary and general manager.

The Valdosta, Fort Gaines & Montgomery has purchased a franchise for a line between Montgomery and Fort Gaines, Ga., of the Montgomery Eastern and will operate the road in connection with a 42-mile line connecting Valdosta and Fort Gaines.

The White Pass & Yukon has engineers in the field for a 120-mile extension from White Horse, Alaska, to Tantalus, or Yukon Crossing, tapping the great Tantalus or British Yukon coal field.

Members of the Executive Committee, T. E. A.

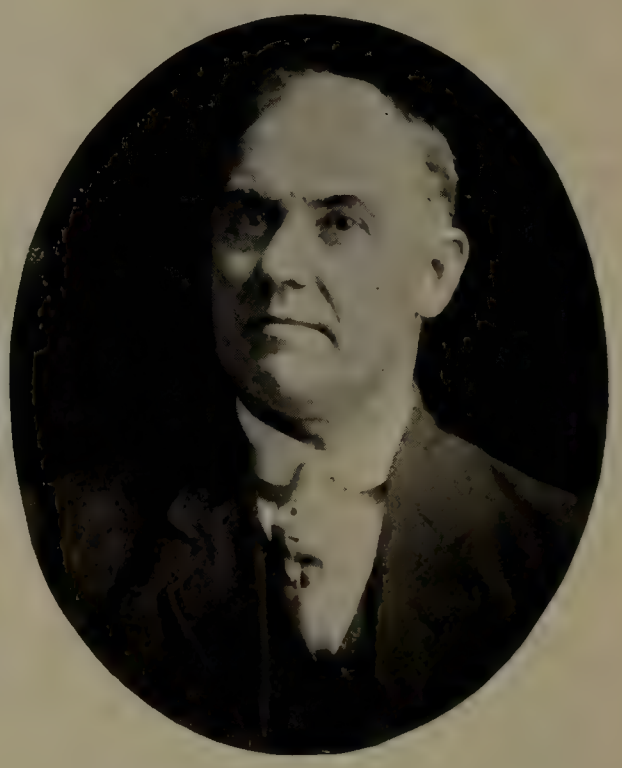
F. C. Thayer, Genl. Rd. Fmn. Eng., Southern Ry.

J. C. Petty, Trav. Engr., N. C. & St. L. Ry.

V. C. Randolph, M. M., Erie R. R.

Robt. Collett, Supt. Loco. Fuel Service, St. L. & S. F. R. R.

C. F. Richardson, V. P., West. Ry. Coal Co., Sturgis, Ky.



M. J. McAndrews, Rd. Fmn. Eng., Mich. Cent. R. R.

Railway Equipment Manufacturers Association

Among the firms which will participate in the exhibit of the Railway Equipment Manufacturers' Association at the convention of the Traveling Engineers' Association, Chicago, Aug. 27-29, inclusive, are the following:

American Arch Co., New York.
American Locomotive Co., New York.
American Steel Foundries, Chicago.
Ashton Valve Co., Boston.
Barco Brass & Joint Co., Chicago.
Bowser & Co., Ft. Wayne, Ind.
Chicago Car Heating Co., Chicago.
Commercial Acetylene Co., New York.
Crane Co., Chicago.
Chicago Pneumatic Tool Co., Chicago.
Dearborn Drug & Chemical Works, Chicago.
Dickerson Mfg. & Supply Co., Clinton, Ill.
Detroit Lubricator Co., Detroit.
Emery Pneumatic Lubricator Co., St. Louis.
Elgin National Watch Co., Chicago.
Flannery Bolt Co., Pittsburgh.
Franklin Railway Supply Co., New York.
Greene, Tweed & Co., New York.
Garlock Packing Co., Palmyra, N. Y.
Galena Signal Oil Co., Franklin, Pa.
Hammett, H. G., Troy, N. Y.
Hunt-Spiller Mfg. Corporation, Boston.
Hobart-Allfree Mfg. Co., Chicago.
Johns-Manville Co., New York.

F. D. Fenn, Crane Co., Treas., Ry. Equip. Mfrs.' Assn.

J. Will Johnson, Pyle-Natl. Elect. Headlight Co., Pres., Ry. Equip. Mfrs.' Assn.

W. L. Allison, Franklin Ry. Supply Co., Sec. Ry. Equip. Mfrs.' Assn.

Jacobs-Shubert Firebox Co., New York.
Jenkins Bros., Chicago.
Keystone Lubricating Co., Philadelphia.
Locomotive Improvement Co., Clinton, Ia.
Locomotive Superheater Co., New York.
Leslie Co., Chicago.
Liberty Mfg. Co., Pittsburgh.
Manufacturers' Exhibit Ry. Supplies, Chicago.
McCord & Co., Chicago.
Mason Regulator Co., Boston.
Manning, Maxwell & Moore, Chicago.
Monthly Official Railway List, Chicago.
Moon Mfg. Co., Chicago.
New York Air Brake Co., New York.
National Boiler Washing Co., Chicago.
Nathan Mfg. Co., New York.
National Tube Co., Pittsburgh.
National Malleable Castings Co., Chicago.
Okadee Co., Chicago.
O'Malley-Beare Valve Co., Chicago.
Ohio Injector Co., Chicago.
Parsons Engineering Co., Wilmington, Del.
Pyle National Electric Headlight Co., Chicago.
Pilliod Co., New York.
Railway List Co., Chicago.
Railway Master Mechanic, Chicago.
Railway Age Gazette, New York.
Storrs Mica Co., Owego, N. Y.
Strong, Carlisle & Hammond, Cleveland.
Sargent Co., Chicago.
U. S. Metallic Packing Co., Chicago.
Watson-Stillman Co., New York.
Winslow, H. L., Chicago.
Ward Equipment Co., New York.

Frank A. Morrison, Mason Regulator Co., Member Ex. Com., Ry. Equip. Mfrs.' Assn.

P. H. Stack, Galena Signal Oil Co., Member Ex. Com., Ry. Equip. Mfrs.' Assn.

W. J. Schlacks, McCord & Co., Member Ex Com., Ry. Equip. Mfrs.' Assn.

Oil Burning Locomotives

(Continued from the June issue.)

Chicago, Milwaukee & St. Paul Ry.

The C. M. & St. P. Ry. has had oil burners in use since July, 1909, and at present has 126 engines in use, embracing a number of different types. These are in operation on the western extension in Washington, Idaho and Montana, and are used principally on the Tacoma Eastern, Coast, Columbia and Missoula Divisions. The general classifications of the engines used together, with their grate areas, heating surface, etc., is shown in the following table:

Number.	Type.	Class.	Grate Area.	Firebox Heating Surface.	Total Heating Surface.
26	4-6-0	G^{4-5-6}	17 sq. ft.	131 sq. ft.	1,403
			18.4 " "	131 " "	1,423
			30.3 " "	182 " "	2,538
4	2-8-0	C^{1}	47.45 " "	185.6 " "	2,423
7	0-6-0	I^{4-5}	22 " "	132 " "	1,312
			25.8 " "	170 " "	1,727
2	4-4-0	H^{7}	17 " "	127 " "	1,215
45	2-6-2	K^{1}	45 " "	238 " "	2,348
10	2-8-2	L^{1}	48.8 " "	188 " "	3,614
16	4-6-2	F^{3-4}	48.8 " "	179 " "	3,910
12	2-6-6-2	N^{1}	72.4 " "	372.6 " "	6,554.6
4	2-6-0	M^{2}	30.3 " "	186 " "	2,535

None of the engines in use is equipped with brick arches, and the Booth burner is used, being located at the front end in the center and 12 ins. above the bottom of the mud ring. Fire box bricks are supplied by the American Arch Company, and their average life is about three months, seam brick lasting about 30 days. These bricks extend upwards from the mud ring a distance of about 18 ins. on either side and on the door sheet to the top of the door hole. Oil tanks have been fitted in the tender space and have a capacity ranging from 756 gallons to 3,300 gallons, depending on the type of engine. Some trouble has been had with deposits in the fire box. These are of an asphaltum form and are caused by careless firing and improper sanding of flues. It has been found necessary to clean these out about every 400 miles the engine makes.

There is an individual storage tank of 50,000 barrels capacity at Tacoma into which the oil tank steamers unload direct. This tank is intended to provide fuel oil in case of shortage on the line of any cause. At this point there is 100 H. P. boiler for heating the oil in case it becomes necessary to force loading into the tank cars from the tank. There are four stand pipes making it possible to load four cars at once. Fuel oil is transferred here to the tank cars from which it is unloaded by gravity into sumps located below the track level at the various stations. Storage tanks of 500,000 gallons capacity are located at St. Maries, Idaho, Othello, Wash., Clellum, Wash., Cedar Falls, Wash., and tanks of smaller capacity are also located at Bovill, Idaho, Malden, Wash., Beverly, Wash., Kittitas, Wash., and Laconia, Wash. Five hundred thousand gallon storage tanks are also located at Avery, Idaho, Alberton,

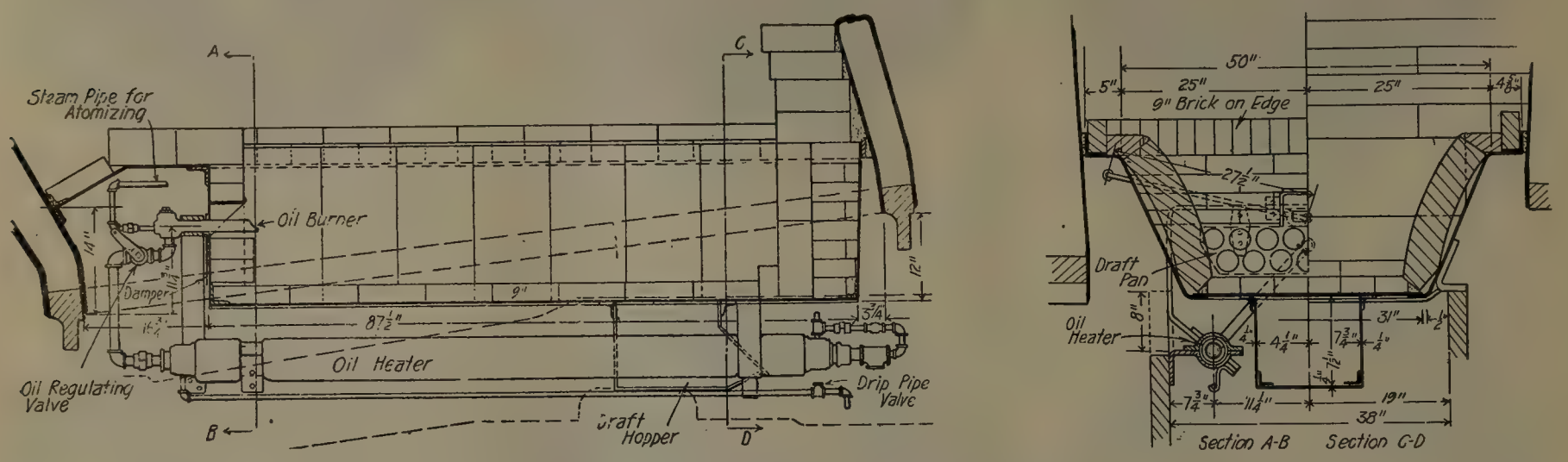


Fig. 33—Firebox Arrangement, C. M. & St. P. Ry.

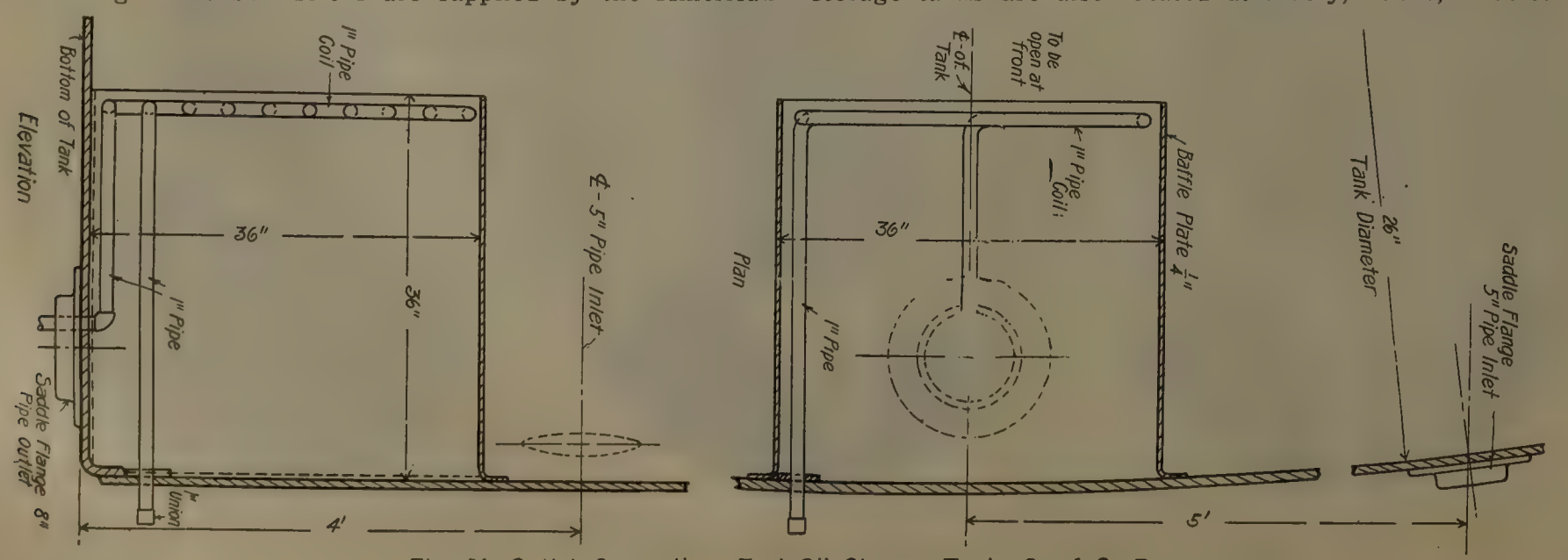


Fig. 34—Outlet Connection, Fuel Oil Storage Tank, C. of G. Ry.

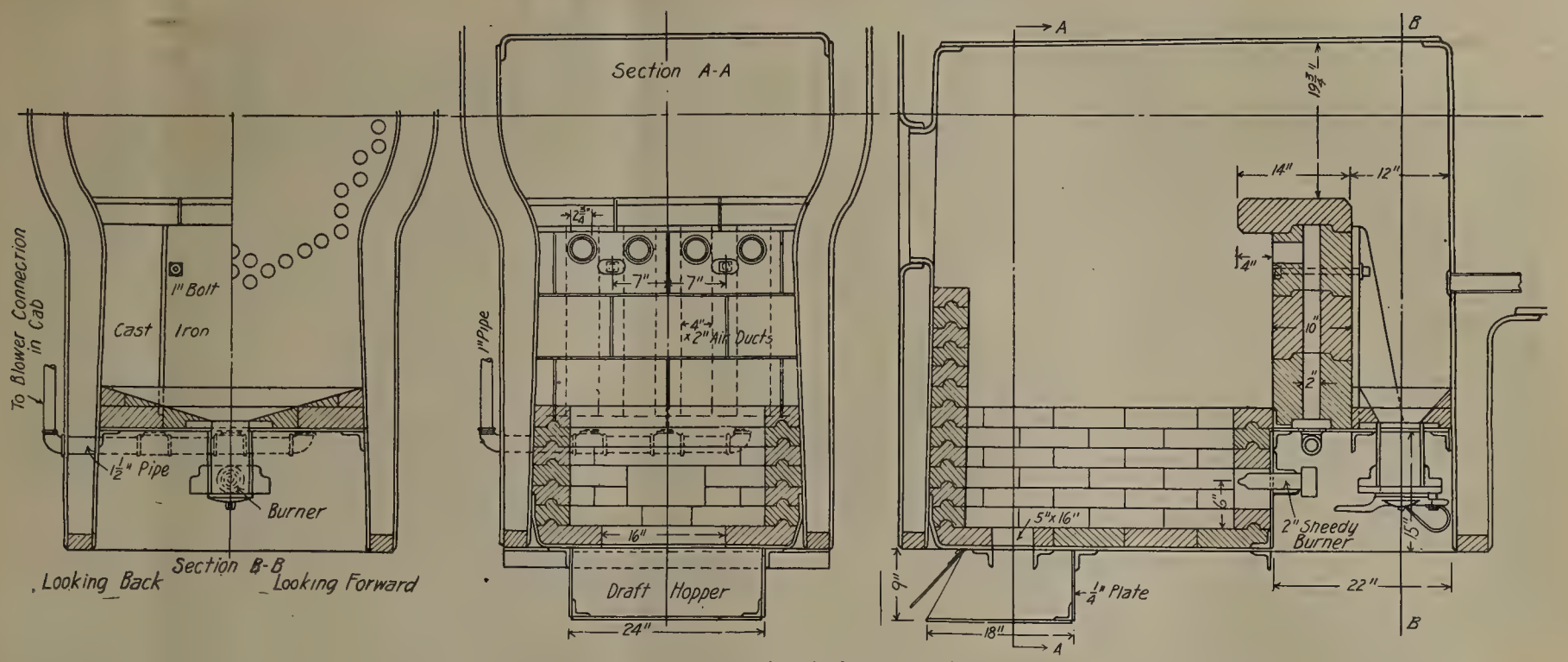


Fig. 35—Sections Through Firebox, C. of G. Ry.

Mont., and Deer Lodge, Mont., with a smaller elevated tank of 54,000 gallons capacity at Haugen. At practically all of these points there are service tanks of 54,000 gallons capacity and the sumps have capacities ranging from 14,000 to 22,000 gallons. The oil burning fireboxes are giving more trouble than coal burners, particularly with the back flue sheet and seams. The expansion and contraction is much greater due to the intense heating, and there has been considerable trouble from breakage of staybolts. Also where the firebox has been improperly bricked, or bricks have fallen away, there has been a tendency for the seams to open up. The beads of the flues have been hardened by the oil, causing them to break off; the average life of a flue in an oil burner being about two years as compared with 3½ years on coal burners. Maintenance of oil burning engines cost about 40 per cent more than coal burning and repairs average about 25 per cent more on flues and seams. Bakersfield, Cal., oil is purchased from the Standard Oil Co. This oil is thick and dark in color, having a calorific value of 19,000 B. T. U. as compared to 11,000 in the coal used, a flash point of 215 degrees F., and has specific gravity of 25 to 31 degrees Baume. The officials of this road state that there is no doubt that considerable credit is due to oil burning engines for the increase in tonnage handled, there being no time on an oil burning engine in good shape, when the boiler pressure cannot be held up to the maximum regardless of how the locomotive is being worked.

No trouble has been had in getting firemen educated to the use of oil, and it is said that they seem anxious to become experts. It is intended that all branch and main line engines from Deer Lodge, Mont., west to Tacoma and Seattle, Wash., shall be equipped for oil burning.

Central of Georgia Ry.

This road has recently equipped six engines for oil burning for use of the Tybee branch, running between Savannah and the seashore. There is considerable suburban traffic on this line and oil was adopted in order to eliminate smoke and cinders, and add to the comfort of the passengers. The engines so equipped are of the eight-wheeled American type with 17x24 in. cylinders. Fireboxes are of the deep, narrow type, having grate areas of 17.3 sq. ft., firebox heating surface of 127.6 sq. ft., flue-heating surface of 1,175 sq. ft., and a total heating surface of 1,302.6 sq. ft. No brick arches are used, but the fireboxes are equipped with the Gaines combustion chamber. A cross-section of a firebox is shown in the accompanying illustration. American Arch Co. brick is used, but the engines have not been in service long enough to determine the effect on the flues and fireboxes.

An oil tank has been fitted into the coal space of the tender mine the average life of the brick. The Sheedy burner is in the usual manner, as shown in the illustration. It will be noted that the oil is heated by the indirect system, that is, by steam coils located in the tank.

A heavy Mexican oil is used and a little coke accumulates around the burner, but it is easily cleaned away and does not interfere seriously with the operation of the engines. Oil is handled at the Savannah terminal and there is one large storage tank, having a capacity of 100,000 gallons. The oil is received from the tank cars of the oil company and is pumped into the storage tanks.

The Martin flexible conduit is used between the engine and tender. The tank valve is similar to that used on the Southern Pacific. The engines have not been in service long enough yet to determine the effect on the flues and fireboxes.

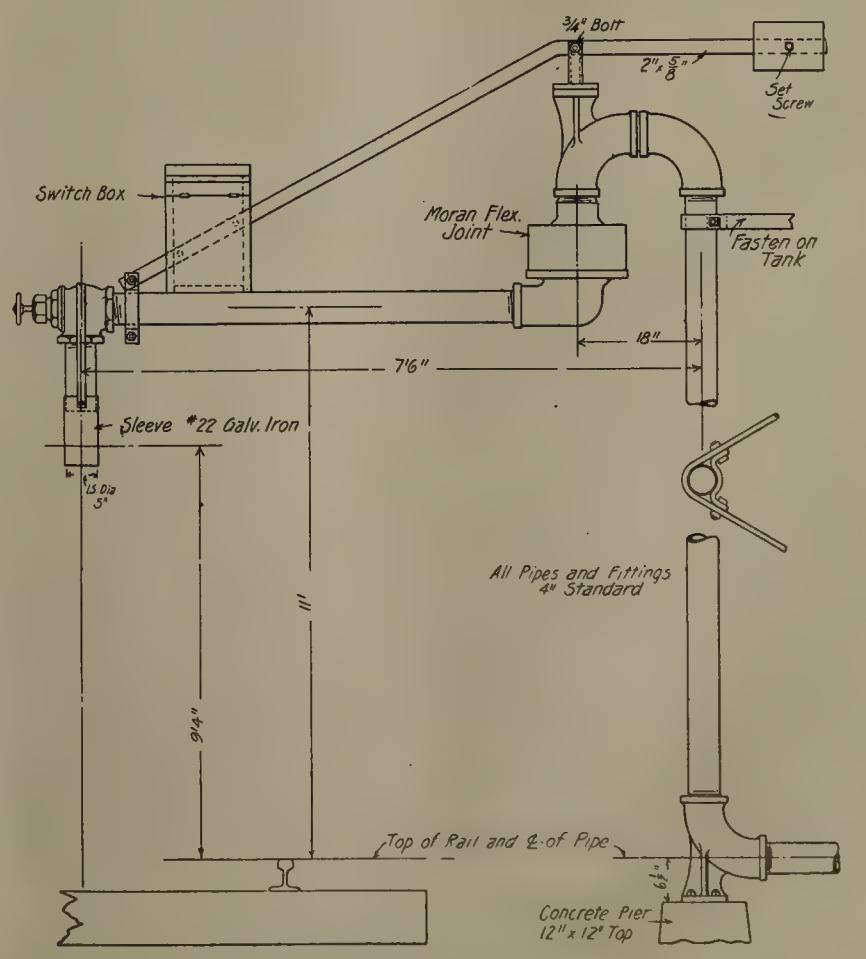


Fig. 36—Oil Stand Pipe, C. of G. Ry.

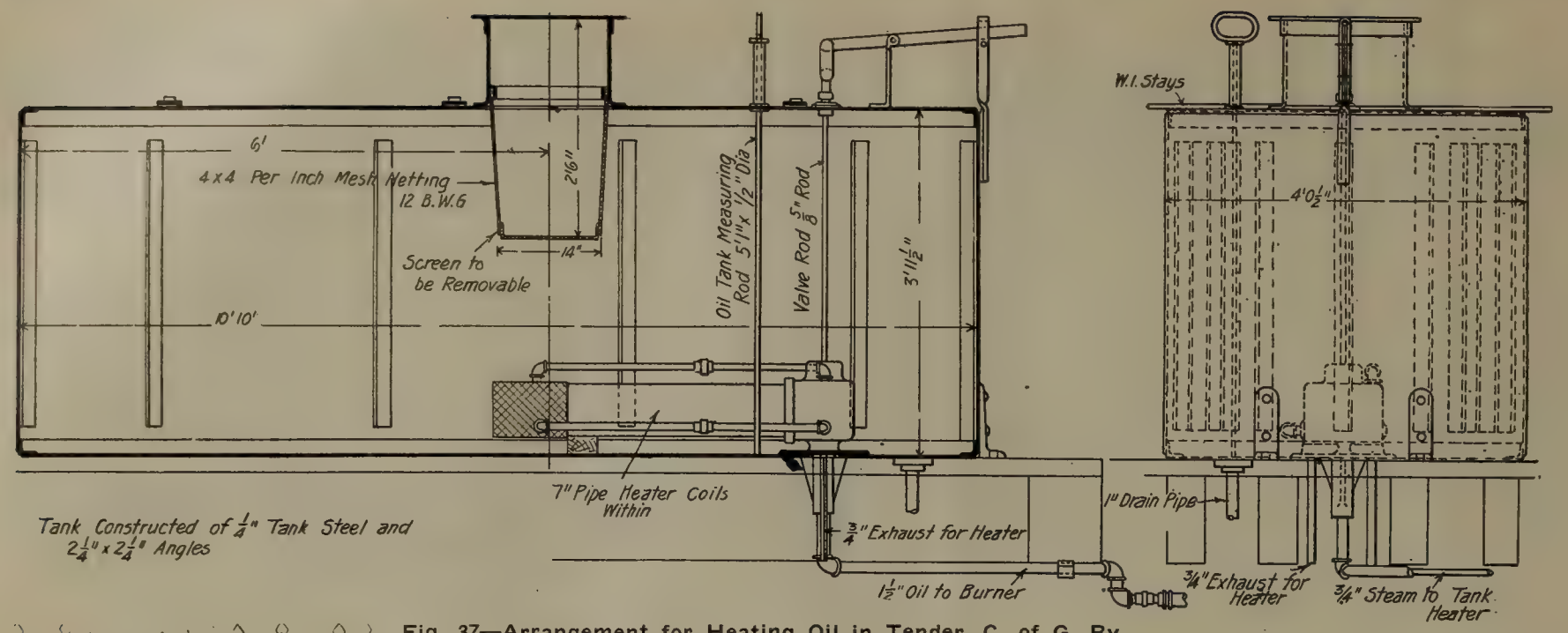


Fig. 37—Arrangement for Heating Oil in Tender, C. of G. Ry.

New York Central & Hudson River R. R.

The New York Central uses 18 oil-burners in the Forest Preserve on the Adirondack division for the same reason that the Delaware & Hudson Co. uses them, to decrease the danger of forest fires. This is the third season that they have been used, the season commencing April 15 and ending November 1st. There are 18 engines equipped for burning oil, being divided as follows: four 4-4-0, two 2-6-0, and twelve 4-6-0. The Von Boden-Ingles burner is used and the engines are not equipped with brick arches. The effect of oil burning on firebox and flues compares very favorably with coal burners and there has been no perceptible difference in repairs.

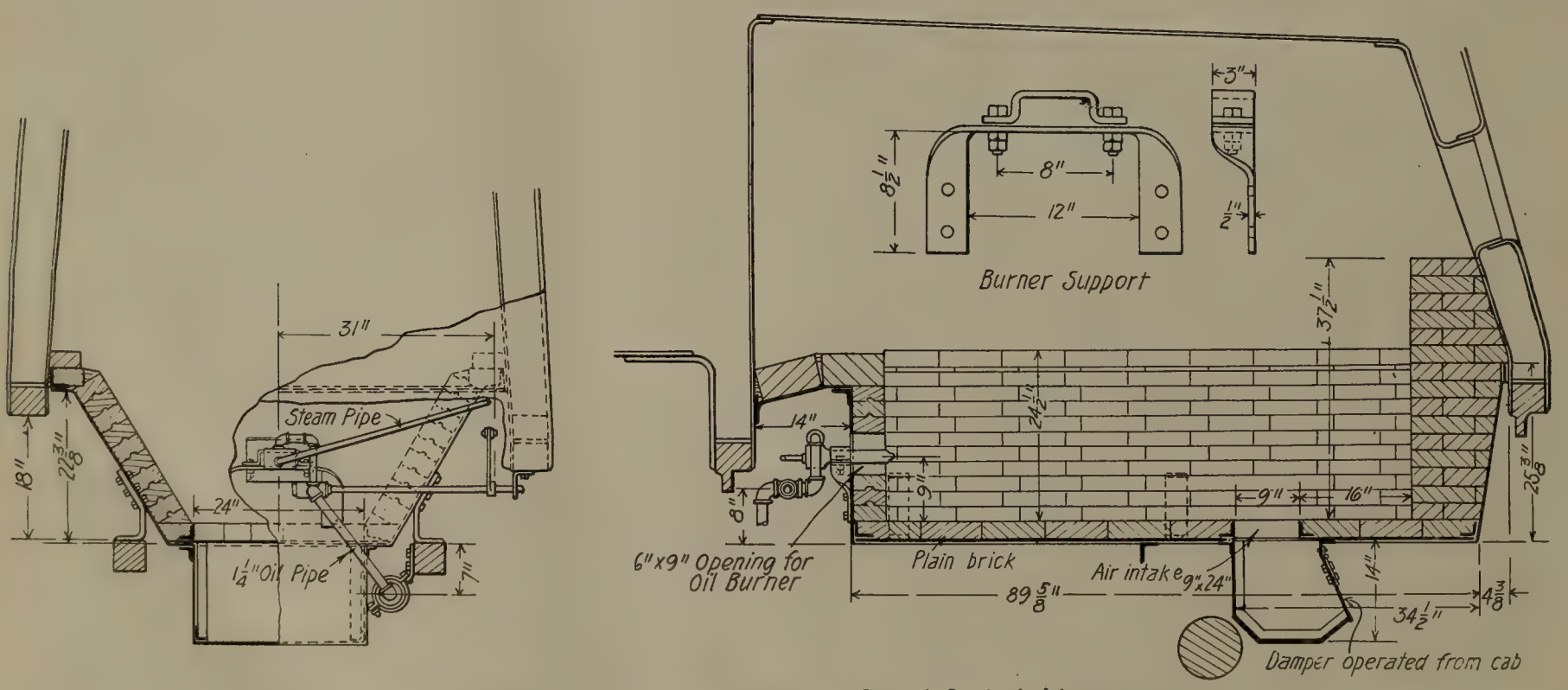


Fig. 38—Firebox Arrangement, Sunset-Central Lines.

Seventeen storage tanks having a capacity of 6,000 gallons each are located at the following places: 5 at Utica, 2 at Fulton Chain, 3 at Tupper Lake, 2 at Saranac and 5 at Malone. The oil is received from the Standard Oil Co. and is known as "Mid-Continental Crude," coming from the middle states. Its flash point is 220 deg. Fahr., specific gravity 28.7 deg. Baume, or .882 and contains 19,398 B. t. u. per pound as compared with 13,214 in the coal used. There has been no increase in engine tonnage and it is not planned to extend its use.

Sunset-Central Lines.

The Sunset-Central Lines compose the Harriman lines in Texas, namely: Galveston, Harrisburg & San Antonio Ry., Texas & New Orleans R. R., Houston & Texas Central R. R., Houston East & West Texas Ry. and the Houston & Shreveport R. R. They have 310 engines equipped for oil burning on these lines, oil having been used since 1900. It is used on all classes, from eight wheelers to Mallets, and on both wide and narrow 3/8-in. steel fireboxes, having grate areas varying from 16 square feet to 53.4 square feet. The heating surfaces run from 1,000 square feet to 3,906 square feet. The method of bricking is shown in the figure, the life of brick being about 2 years. No brick arches are used. The Sheedy burner is used, being located in the front and about 30 in. from the flue sheet and 9 in. above the bottom of the brick pan. No trouble has been experienced with deposits in the firebox and there is little difference in repairs as compared with coal burners. Assistant General Manager Small says: "When proper oil burning arrangement is installed and firemen are experienced and competent, the life of flues and fireboxes is about the same as with coal burners."

Oil is received at Algiers, Lafayette, Echo, Beaumont, Houston, Glidden, San Antonio, Del Rio, Sanderson, El Paso, Ennis and Hearne, storage tanks being of steel with cement bottoms. Tank cars having a capacity of from 6,500 to 12,850 gallons are used for transportation purposes only. Crude oil is purchased in Texas, Louisiana and Oklahoma. This is of a greenish and reddish color having a viscosity compared with water of 1.11 to 1.3 and a calorific value of from

19,048 to 19,246 B. T. U. per pound. It has a flash point of from 100 deg. Fahr. to 136 deg. Fahr., a specific gravity of from .9021 to .9363 at 60 deg. Fahr., carbon content of from 83.5 to 85 per cent and sulphur content ranging up to 2 per cent.

The value of fuel oil per ton-mile is .024 cents and there has been no difficulty in getting the men to use the oil efficiently. There has been an increase in engine tonnage of about 10 per cent and it is contemplated to extend its use.

The fire pan is lined throughout with a single row of interlocking tongue and groove fire brick 2½ x 4½ x 9 inches except on the horizontal sides, where the fire pan is in steps due to the sloping mud ring where the bricks are several rows deep. On the bottom of pan the bricks are laid to the 2½-inch depth, the sides 4½-inch depth, and are held to side sheets with anchor bolts let into bricks and afterwards covered over with fire clay. The vertical wall at burner

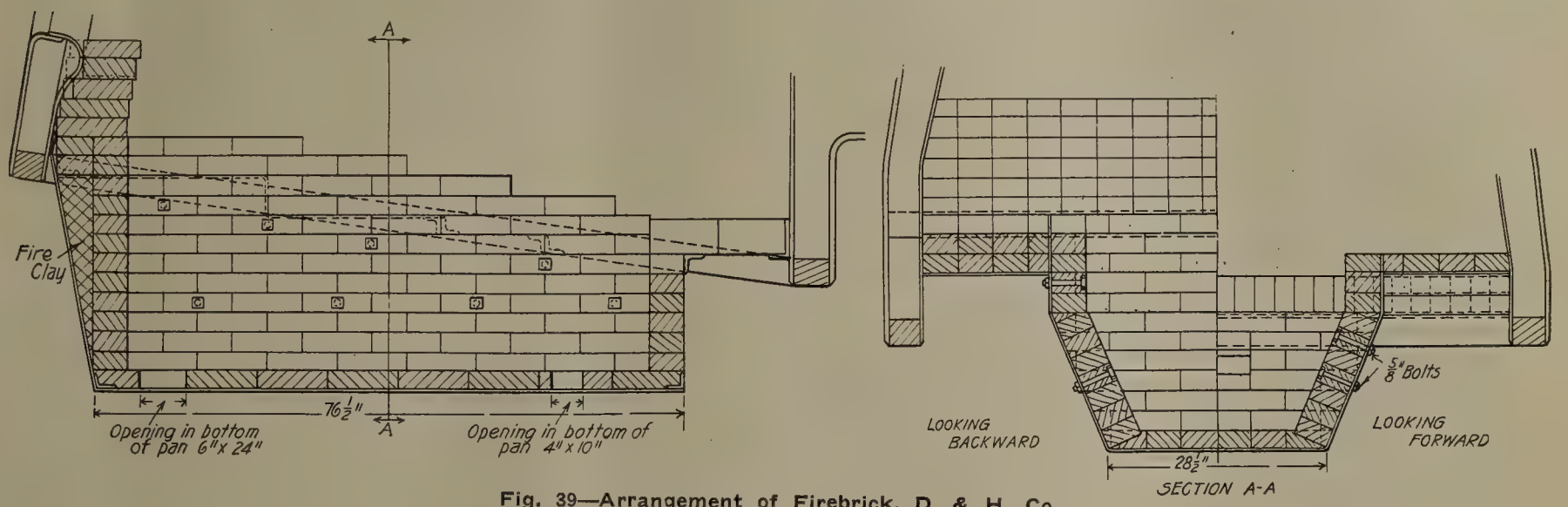


Fig. 39—Arrangement of Firebrick, D. & H. Co.

Delaware & Hudson Co.

The Delaware & Hudson has had 12 oil burners in use on the Chateaugay branch of the Champlain division in the Adirondack mountains for about 3 years. This is done to lessen the dangers from forest fires. The fireboxes are all of the narrow type, five being of the 2-6-0 type, six of the 4-6-0 type and one of the 2-8-0 type. The 2-8-0 and one of the 4-6-0 are equipped with superheaters. The 4-6-0 and 2-8-0 types have fireboxes over the frames and the 2-6-0 have boxes between the frames. Grate areas and heating surfaces are as follows:

Type.	Grate Area.	Heating Surface.
2-6-0	36.75 sq. ft.	1,615 sq. ft.
2-6-0	28.83 sq. ft.	1,118 sq. ft.
4-6-0	50.17 sq. ft.	2,789.7 sq. ft.
4-6-0	50.17 sq. ft.	2,270.7 sq. ft.
2-8-0	53.3 sq. ft.	2,398.4 sq. ft.

has a 4½-inch depth, back wall at the fire door a 4½-inch depth for a vertical height of 30 inches, remaining height 9-inch depth, this wall being held in place by metal anchors. On the shelf between front vertical wall and front of firebox the bricks are placed to a 4½-inch depth, overlapping the bricks at the front vertical wall. The life of the bricks is about five months.

The narrow firebox, 2-6-0 type, has a 9 x 10 x 3-inch brick arch located directly over the burner at the front of the pan, the underside of which locks at the ends with the firebrick. The firepans are of ¼-inch steel plates and are of the box type construction as follows: 3½ inches from the bottom of front mud ring there extends horizontally a 14-inch shelf which drops vertically 17½ inches to the bottom of the fire pan and extends 76½ inches toward back mud ring. The transverse shape is 28 inches at the bottom, flaring out to 43¼ inches at the top and extends over horizontally to side sheets. The pan is held to mud ring by

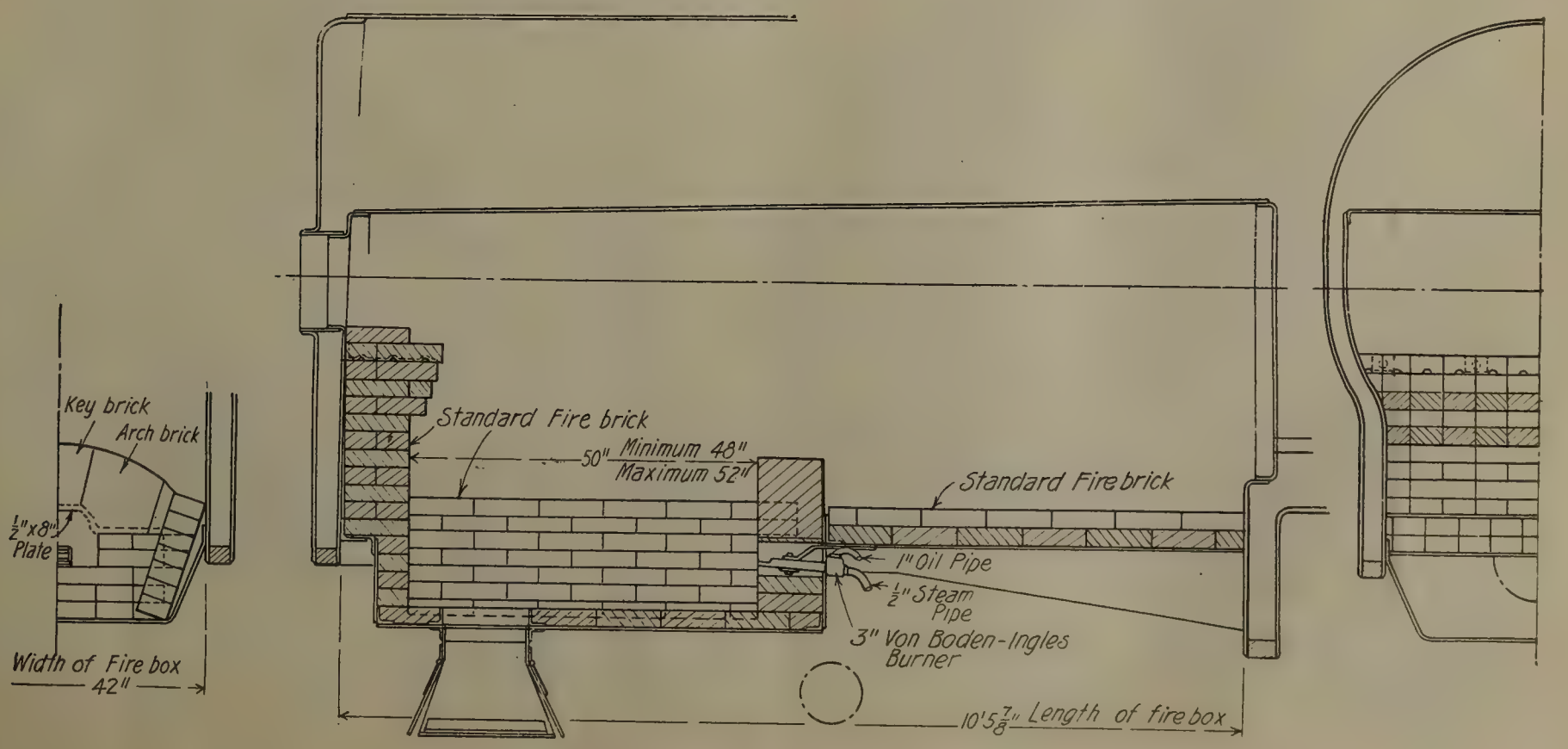


Fig. 40—Firebox Arrangement, D. & H. Co.

three 3 x 5-inch "T" irons, and in the bottom of pan there are two air openings. The front opening is 4 x 10 inches, back opening 6 x 24 inches, which in turn are covered by hoppers operated at the back mud ring. The center line of burner is 10½ inches from bottom of pan located at the front vertical wall. The Von Boden-Ingles burner, having widths of 3 inches and 3½ inches, is used.

Oil is furnished to engines by the company's transport tank car, oil being obtained from the Standard Oil Company. This oil has a calorific value of 19,500 B. T. U. as compared with 11,500 in the coal used, a flash point of not less than 120 deg. Fahr. and a specific gravity of between 13 deg. and 25 deg. Baume. There has been no increase in engine tonnage and the cost per ton-mile for fuel is .0182. Mr. Manning has issued an excellent book of instructions for the use of firemen and in addition has a traveling fireman doing instructional work. It is not expected that the use of oil will be extended on the Delaware & Hudson.

Tehuantepec National Ry.

An article descriptive of oil burning practices on this road was given in the March issue of the *Railway Master Mechanic*. In brief they are as follows: This road has a length of 189 miles running across the Mexican isthmus of Tehuantepec and is plentifully supplied with curves and grades. A burner very similar to the Booth is used and it is located toward the front end, at a distance of about four feet from the flue sheet. The locomotives are of the Baldwin consolidation type and are not equipped with brick arches. Cylinders are 20 in. x 26 in., grate area 24.94 sq. ft., and total heating surface of 1,847 sq. ft. No bad effects have been experienced on fire boxes and flues, and in fact it is said that oil burning has not proved so injurious as coal burning. In using Mexican oil, some trouble has been experienced with deposits in the firebox. This Mexican oil is jet black with a heavy asphalt base and has only been used recently. Previously Texas oil was used. This oil has a calorific value of about 19,000 B. t. u., a flash point (open) of 104° F. and contains 3.44 per cent of sulphur. The Texas oil ran about the same in heating value with an open flash point of 160° F. and sulphur content of .77 of one per cent. All the fuel oil is received at the terminal at Puerto, Mexico, where there are three steel tanks having a total storage capacity of 130,000 barrels. At Salina Cruz there are two tanks having a total storage capacity of 90,000 barrels. Oil is shipped from these terminals to other distributing points in steel-frame tank cars of 6,600 gallons capacity.

Moscow-Kazan Ry.

In contrast to the methods employed on American roads, we show the oil burning arrangements on the Moscow-Kazan Ry. of Russia as typical of Russian practice. Russia, it will be remembered, is the first country in which oil was used as a fuel for locomotives. This road operates in central Russia, chiefly between Moscow and Kazan, a point on the Volga river.

The burner on this road is located at the rear of the firebox, that is beneath the fire door, and the engines are equipped with brick arches. The location of the burner is the reverse of American practice, where the burner is located at the front end. Figure 41 shows a longitudinal and cross-section view of the firebox and bricking of a 4-6-0 passenger locomotive. It will be noted that the bricking extends across the rear end of the firebox to a height above the fire door. Figure 42 shows two views of the burner employed, which it will be seen is radically different from those used here. Figure 43 shows its loca-

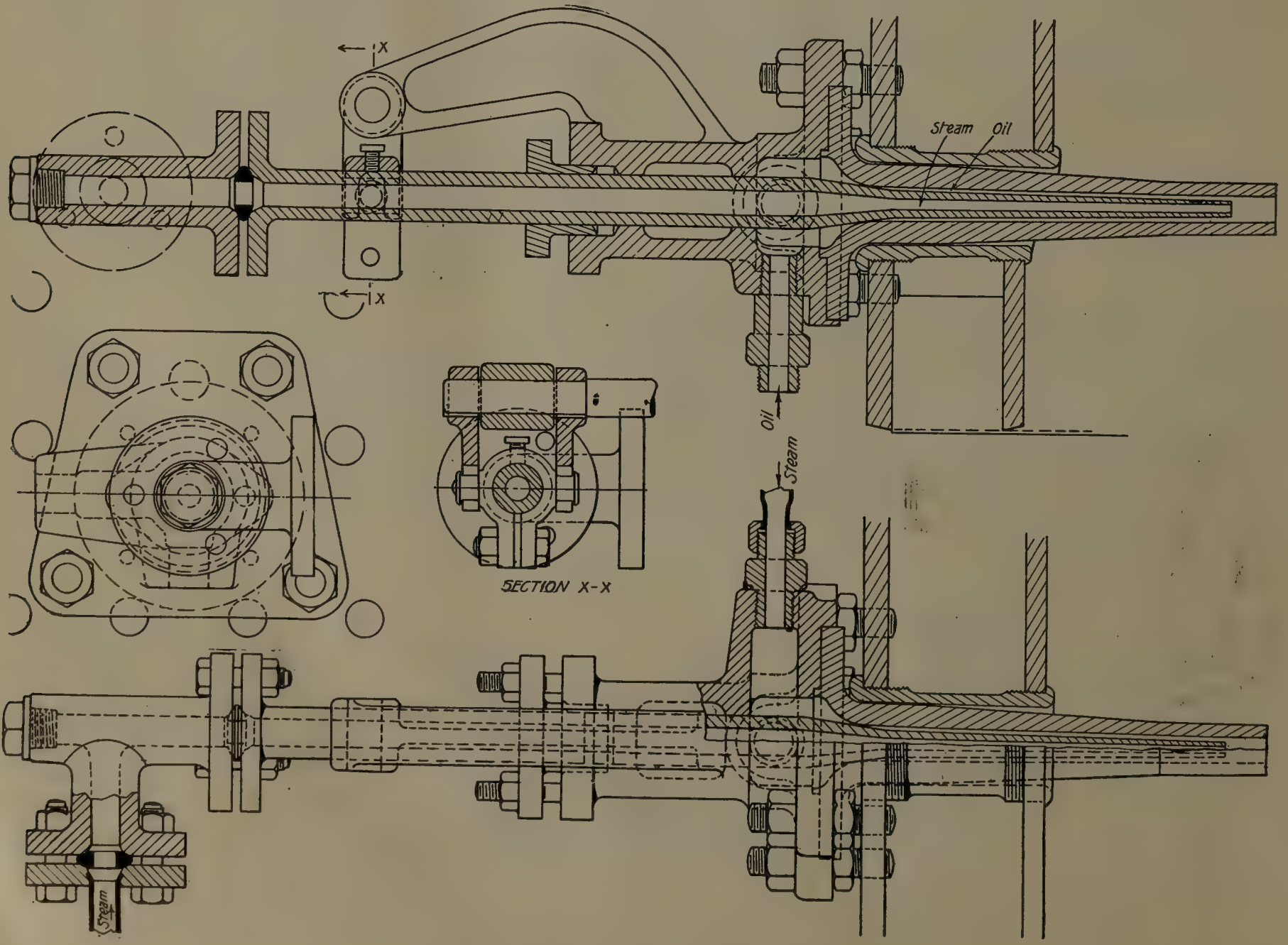


Fig. 42—Views of Burner, Moscow-Kazan Ry.

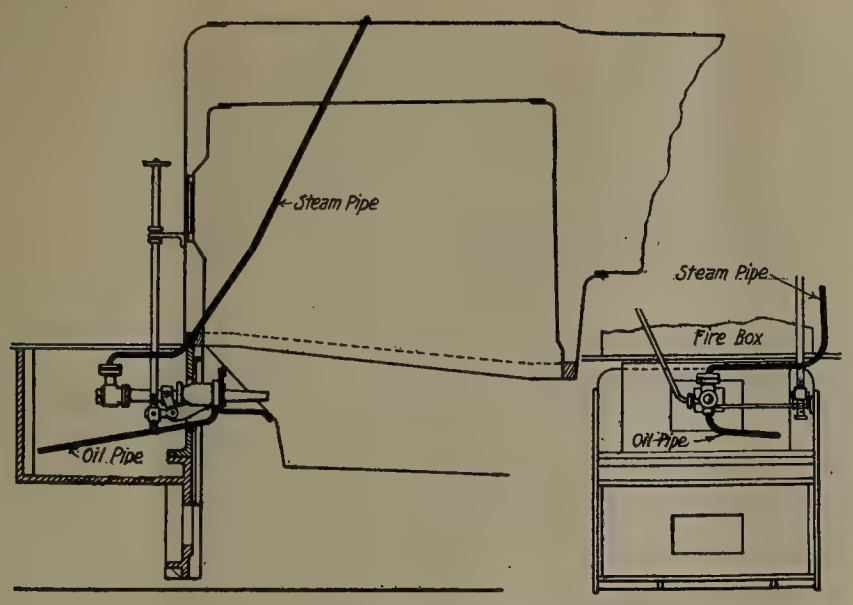


Fig. 43—Two Views of Burner and Firebox, Moscow-Kazan Ry.

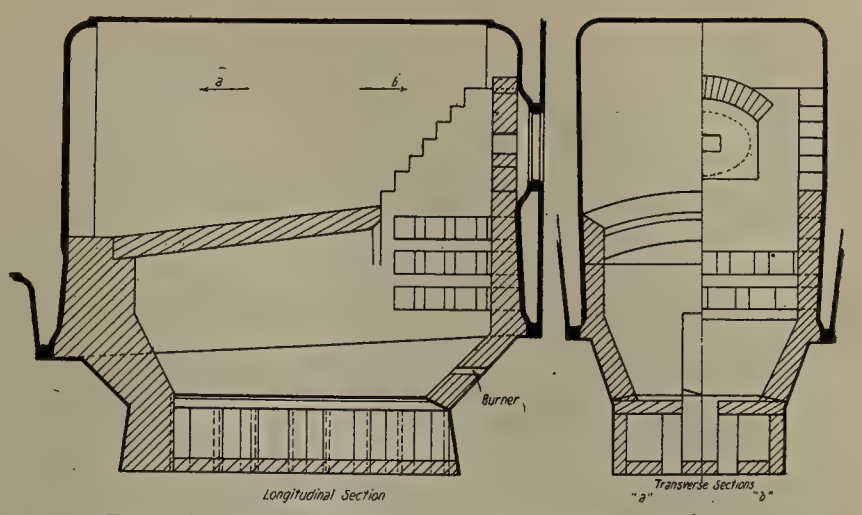


Fig. 41—Views of Firebox, Moscow-Kazan Ry.

tion in the firebox. In the burner it will be noted that the oil enters a chamber in a casting which is bolted to the outside of the firebox. This casting projects through the sheets into the firebox in the shape of a tapering tube. Steam for heating the oil enters the above mentioned chamber through an opening at right angles to the oil opening. A long brass tube extends clear through the casting containing the oil chamber and is tapered so that it can entirely close the opening between the chamber and the iron tube. Steam passes through this inner brass tube and draws the oil through the tube surrounding it. The brass tube, it will be noted in Figure 42, is moved backward or forward, thus regulating the flow of oil.

The oil used on the Moscow-Kazan Ry. is from the Bakoo oil fields, contains 82 per cent carbon and has a specific weight of between .89 and .94 and 0° C. The whole output of the Bakoo fields, destined for central and eastern Russia, is shaped during the navigation period, by water-way to the ports on the Volga river, especially Tzaritzyn, Samara, Syzran and Nishni-Novgorod. At these points it is stored in large steel tanks or concrete basins and is shipped from thence in tank cars to the consuming points. The Moscow-Kazan system is about 1,400 miles in length and the oil is delivered from Syzran, a station on the system, to fourteen oil stores connected with the round-houses. At each of these points there are steel tanks of from 20,000 to 27,000 barrels capacity, provided with a pumping plant for pumping the oil from the tank cars to the storage tanks and thence to the small distributing tank, a cross section of which is shown in Figure 44. Oil is used only on passenger locomotives on the main line and on freight locomotives on

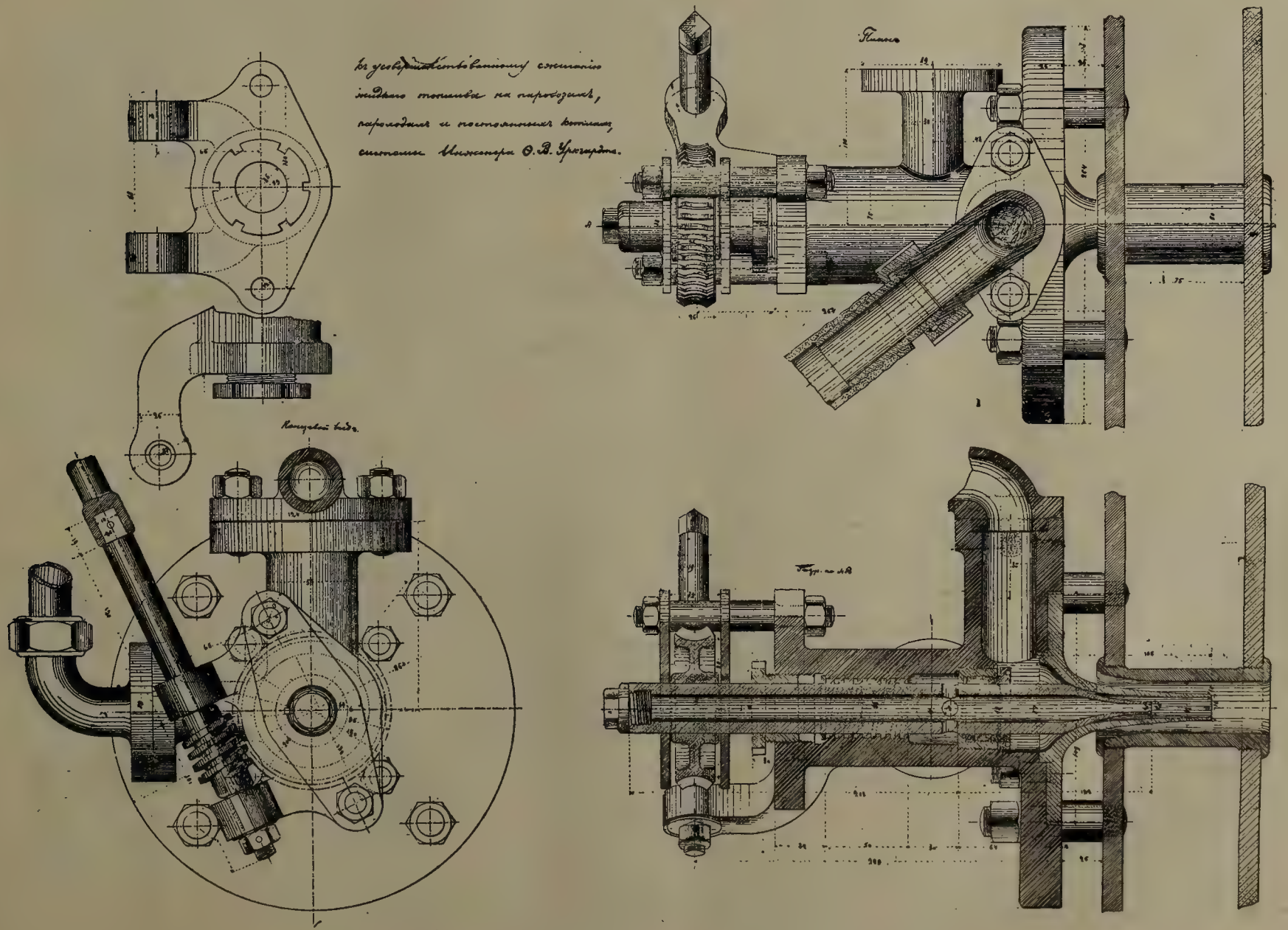


Fig. 45—Burner Used on the South-Eastern R. R. of Russia.

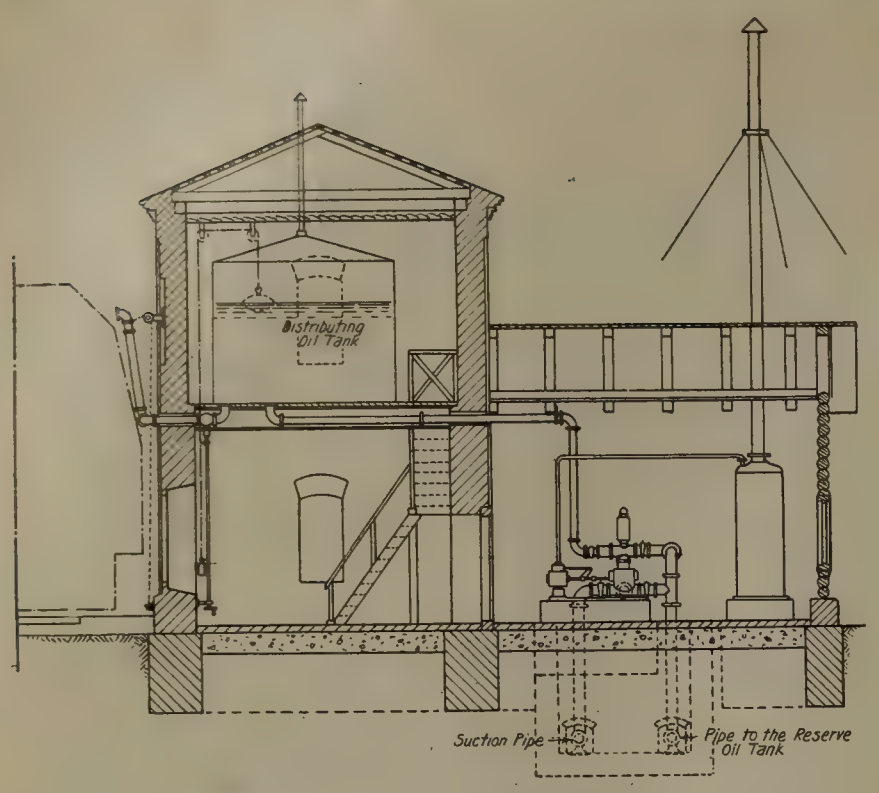


Fig. 44—Distributing Station, Moscow-Kazan Ry.

several branches where special conditions have to be dealt with. The relative amounts of coal and oil used are as ten to six, that is, about twice as much coal as oil is used. The use of oil has been satisfactory and it would be used on all locomotives, if it were not for the fact that its cost makes it commercially impossible, the present price of oil being about $1.06 per barrel.

The South-Eastern Railroad of Russia.

The South-Eastern Railroad uses a certain residue of naptha called "Mazoot," which is the product remaining after the lighter volatile substances such as kerosene, gasoline, benzine, etc., are distilled. Its specific gravity must not be higher than 0.912 and the flash point not lower than 70 degrees C. According to the specifications, it must not contain mineral acids or alkalies or any non-combustible substance. It is obtained from the Caspian districts, and especially from the Bakoo oil field, as the naptha coming from other sources contains considerable paraffine, which partially solidifies in cold weather and refuses to flow freely.

The refineries operates steamers on the Volga River, and the oil is delivered to the South-Eastern Railroad at a station not far from the city of Tsaritsin. The oil, after having been approved by a commission, is transferred into tanks on the shore, having a capacity of about 25,000 barrels each. It

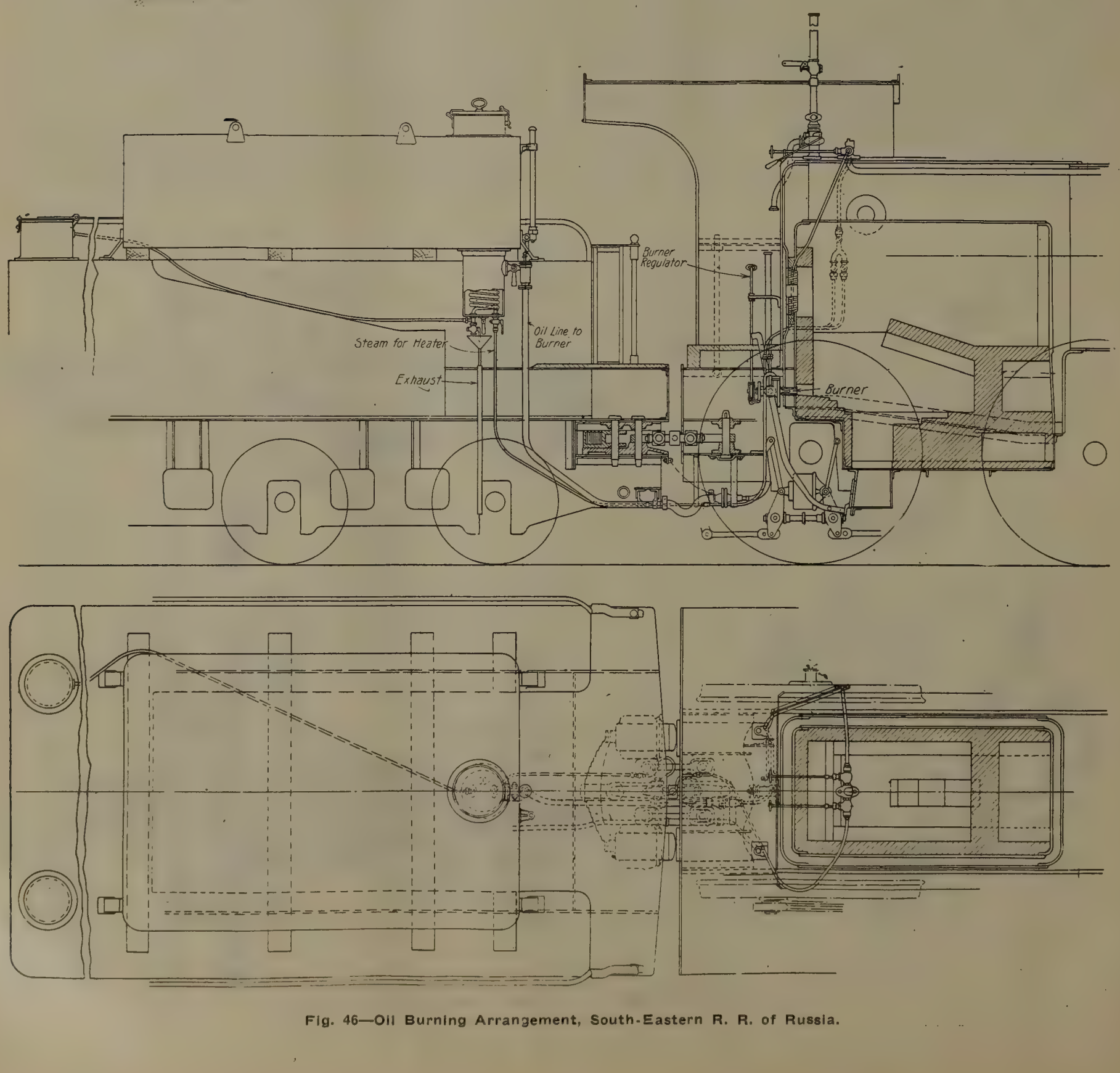


Fig. 46—Oil Burning Arrangement, South-Eastern R. R. of Russia.

is allowed to stand in these tanks for several days in order that the settlement and amount of water may be determined. The amount of water is deducted from the weight of the oil and is not subject to payment. Tests for determining the amount of water are made immediately after filling the tanks, and again after the oil has stood for a week. A portion of the oil is distributed directly over the lines and the remainder is placed in a storage reservoir, having a capacity of about 200,000 barrels. In transferring the oil from the boats to the tanks on shore, a floating pump is used which has a capacity of about 8,000 barrels in 24 hours. Together with the smaller tanks there is a total storage capacity of about 280,000 barrels at this point.

The oil is transported over the system in tank cars of about 30,000 cars capacity, to 25 fully equipped oil stations. The equipment of these distributing stations consists of an iron oil tank of 15,000 barrels capacity, a Worthington oil pump, an oil reservoir of about 100 barrels capacity, together with the necessary distributing pipes.

The following table gives the amount of coal and oil used, together with the cost of same.

Years	Bituminous coal in tons	Bricketted coal in tons	Anthracite coal in tons	Oil in barrels
1907	437,000	35,400	105,000	172,490
1908	527,000	46,100	50,600	136,519
1909	489,000	26,300	29,100	365,957
1910	450,000	22,200	14,380	457,795
1911	410,940	17,250	11,200	655,233

Costs.

Years	Bituminous coal per ton	Bricketted coal per ton	Anthracite coal per ton	Oil per barrel
1907	$2.71	$5.53	$3.04	$1.80
1908	2.90	5.63	3.28	1.57
1909	2.89	5.76	3.58	1.46
1910	2.92	5.77	3.37	1.18
1911	2.76	5.76	3.25	1.15

The arrangement of the tender, firebox and connections of a 0-4-0 locomotive is shown in the accompanying illustration. The burner used is similar to that in use on the Moscow-Kazan Railway and was designed by the engineer of the South-Eastern Railroad, Mr. Urhardt. It will be noted that the locomotives are equipped with brick arches and that the burner is located at the rear end. On the South-Eastern Railroad it is considered profitable to use oil in locomotives, notwithstanding the higher expense, as it results in many economies, viz.: difference in the length of runs made with oil, reduction in the cost of running repair expenses, reduction in the number of employes, and an economy of yard and roundhouse space, as compared with coal-burning locomotives.

Following is a table outlining some of the more important information with respect to various roads in America as given above.

Road.	In Use Since	No. Locos.	Where used	Brick Arch	Effect on Sheets and Flues	Burner	Oil				Cost per ton-mile for fuel	Increase in Engine Tonnage
							Where Obtained	Calorific Value	Flash Point	Sulphur		
A. T. & S. F.	1887	865	South-western divisions	No	"No definite information"	Booth	Local fields	16,740 B. T. U.	83° F.	1.88%	.0270 cents	None
Can. Pac.	Now being equipped	90	British Columbia	No		Von Boden-Ingles	California					
Cent. of Georgia	1912	6	Georgia	No	Not yet determined	Sheedy	Mexican Oil					
Chi. & N.-W.	1911	25	Wyoming and Nebraska	No		Booth	Wyoming		110° F.			
C. M. & St. P.	1909	126	Wash. Ida. and Mont.	No	Repairs average 25% more	Booth	Bakersfield, Cal.	19,000	215° F.			Some
Chi. R. I. & P.	1908	69	Herington, Kan., to Waurika, Okla.	Yes	"A little harder than coal"	Von Boden-Ingles	Kansas and Oklahoma					15 to 20%
D. & H. Co.	1909	12	Adirondack Mountains, N. Y.	On some	"No trouble as yet"	Von Boden-Ingles	(Standard Oil Co.)	19,500	120° F.		.0182	None
G. H. & S. A.	1900	310	Texas.	No	Little or no difference	Sheedy	Tex. La. and Okla	19,200	118° F.	2%	.024 cents	10%
Great Nor.	1911	115	Spokane and Cascade divisions	No	"Probably a little shorter life"	Von Boden-Ingles	California	18,500	190° F.		.0487 cents	About 3%
N. Y. C. & H. R.	1909	18	Adirondack Mountains, N. Y.	No	"No perceptible difference"	Von Boden-Ingles	"Mid-Continental"	19,398	220° F.			None
San A. & A. P.	1900	81	Entire system (Southern Texas)	No	"Reduces life 30 per cent"	Sheedy 3 in.	Beaumont and Humble fields, Texas	19,000	200° F.	1.0 %	.0347 cents	25%
Sn. Pac.	1900	1239	On entire Pacific system except east end of Salt Lake division	No	"No bad effects if properly arranged"	Von Boden-Ingles	San Joaquin Valley, Cal.	18,500	250° F.	.83%		
Tehuantepec National	....	60	Southern Mexico	No	"No trouble whatever"	Booth	Texas and Mexico	19,000	160° F. and 104° F.	.77% and 3.44%		
West. Pac.	1909	67	California and Nevada	No	"Very little trouble"	All commercial types	California					

THE MASTER MECHANIC AS AN INVENTIVE GENIUS.

By Louis Brentnall.

Seeing, as he does, the various ways in which different workmen handle work or run machines, the average master mechanic naturally makes many improvements in the working methods pertaining to his shop. He has a wide field, too, for employing inventive genius, due to various advanced conditions which require better handling or improved facilities.

Only a few years ago a master mechanic who took an inventory of a lot of old machinery in an abandoned shop at the end of the line, found antiquated machines, with the use of which he himself admitted he was unfamiliar. The company wished a value placed on them, with the view of crediting the mechanical department and returning the machines to storekeeper's stock for reissuing or selling, but not belonging to an Ananias Club and having a conception of the tortures of the Inferno by reason of long railroad experience, he did as all honest master mechanics would do—took no credit for those "d——d old cripples." "I simply numbered them," he said, "and listed them. In value column I put the notation, 'Weigh and sell for scrap.'"

Almost any master mechanic may encounter out-of-date machinery in assuming charge of the shops on a "Long, Narrow, Awkward, Crooked & Antiquated railroad," and find it necessary to employ inventive genius in getting the machines to run, or other ability in getting the company to scrap them. The latter means may be difficult should the "brass Collars" belong to the same period as the machines, although, of course, superior officers are usually the best of men.

As an inventive genius, even with modern facilities, there are two features which a master mechanic can keep foremost in mind, i. e., getting the time limit to the minimum in performing different work, and improving upon different methods and facilities so as to expedite the handling of jobs. This is somewhat different from the procedure of handling work in routine fashion, as it includes at the same time the watching of the work and improving upon the method of handling it wherever possible. Again, the facilities required may be such as must be rigged up, in order to facilitate working methods.

On account of being practical men, some master mechanics may think they have no inventive genius, yet they are apt to be mistaken in this, as the hardest thing for a man to do is to define himself or his ability. Inventive genius lies dormant in many a master mechanic and simply needs to be aroused. Occasionally a master mechanic is an officeman or business man, instead of being a thoroughly practical mechanic, yet he, too, has inventive ability, even though he may be unaware of it.

Usually an invention is a *created product.* Its need may be, first suggested from a practical standpoint, as by a master mechanic noticing the inefficient way in which certain work is handled. As an example, let it be assumed that his problem is that of improving upon the way of loading cinders from engine pits into cinder cars, instead of having them first shoveled out of the pit onto the ground and then from the ground into the cars. He may first wish to inform himself whether there is any device or equipment on the market for emptying pits and loading cinders, as by reading the advertising columns of Railway Master Mechanic. Finding nothing, he then seeks the means for accomplishing an end.

Just think of what has been accomplished in this direction in the outside world during the past few years! Edison has given us the electric light and the phonograph. Marconi perfected that little instrument which in a minute made known the disaster of the Titanic and brought the Carpathia at full speed. A Chinaman once said of the electric street car, "No pushee, no pullee, allee samee goee like hellee." With similar ideas in their heads, mechanics or inventors soon produced a sister conveyance—the automobile. One invention suggests another. The first telegraph had two wires to a line in order to establish a complete electric circuit, until a lineman discovered that messages could be sent with one of the lines down on the ground, so the natural consequence was to use the ground to complete the circuit instead of having two wires, and finally Marconi—knowing he could use no wires on the ocean, employed means for bringing about a necessary end—perfected wireless telegraphy.

A master mechanic may use his inventive genius in a similar way. His practical experience or observation *first suggests some end to be accomplished,* such as the desirability of loading those cinders from the pit directly into the car. With the object to be accomplished in mind, the *means* should be sought. He may not at first have any particular idea of how to accomplish the desired result. It may be the same with a hundred other things he wishes to improve in or around the shop. How is he to accomplish the end?

Simply by seeking the means. He need not go about blindly trying to accomplish the result, because he already knows what is to be improved and need only seek the means. Here his mechanical knowledge comes into fine play, for it enables him to look squarely into the proposition before him. He may draw an outline of the pit, or sit near the pit and study his problem. Some inventors "dream" with their eyes wide open—they see beyond. A high official in practical railroad engineering recently said that fully one-half of his work required the employment of *imagination.* He was given problems or ends to be accomplished which oftentimes were new and at first seemed almost impossible. How did he accomplish them? (He has surmounted inventive difficulties many a time.) In the same way the master mechanic can do.

With the outline of the cinder pit in mind, *think* about the pit. There is no need for any severe mental effort. When one is tired, he should rest. Nothing may be thought of today. Tomorrow, while resting leisurely, the facetious idea of an air ship descending and scooping the cinders up with some unknown contrivance, may suggest itself. One's imagination is apt to suggest almost anything. In this instance it suggested a *scoop*—the air ship being immaterial, or the fickle part of the imagination, the practical part being the scoop. Dream over ways of operating the scoop and some contrivance will be invented before you know it.

Again, when a certain end is desired or something is to be invented, a master mechanic may bring his practical knowledge into good use. The proper idea is all that is needed to map out a device. One's imagination or "dreaming powers" may suggest the idea, when the matter of applying mechanical principles to operate the device can be worked out. A scoop having suggested itself as a means for handling the cinders, is there anything else that could be used? How about conveyors? Could an elevator be used? How about using an elevated track, with a steel car under it? Many other ways can be thought of by the master mechanic who employs his inventive genius. He *has* this ability. It is simply a matter of developing or extending it.

The foregoing gives the general principles of the "workings of the mind" in accomplishing the result. Many men who have known what improvements were needed have heretofore left them behind for accomplishment by "the other man," and some of these problems are before the master mechanic.

An invention is seldom perfected at first trial. For instance, whatever means are decided upon for emptying the cinders out of the pit into the car, it may be but a crude arrangement at first—a sort of a makeshift, but it may include the main idea or principle, and the device is further improved by actual test, when practical experience suggests such re-

arrangements or additions as are necessary, until finally the device is perfected.

Now, one little invention might not amount to much if the railroad of today was as in the days of old, with perhaps but one or two shops or cinder pits on the whole line, but considering that a cinderpit is at every watertank, coal chute or roundhouse along the hundreds of miles of roadway, the handling of so small a feature as loading cinders amounts to a large saving with the device in use at hundreds of pits. Cinder pits, of course, are merely mentioned by way of an example of the subject. The employment of inventive genius pertains to the shop as well, and especially to the mechanical department.

A master mechanic may profit in after years from the employment of his inventive genius. An invention which is good in one shop, or on one railroad, is likewise useful on other railroads. There are thousands of railroad shops. Instead of a master mechanic retiring from service with meager means, he may obtain royalties from other railroads on the devices he has perfected, simply by opening the palm of his hand, as some factory may manufacture the device under their own supervision, while some supply house does the selling.

A man of ordinary means is seldom in position to market his invention. The necessary experimenting alone, in perfecting a device, amounts to considerable, but this amounts to little in the case of a railroad, for the reason that most officials are glad to have master mechanics improve working methods by inventing special devices, contrivances or machines where these cannot be purchased in the open market. A plan based on mutuality is that of the master mechanic having the railroad handle the patenting of the device he has perfected, on consideration of his assigning to them the right to use the device on the home line free of charge—the railroad, of course, standing the expense of obtaining the patent, as well as the cost of manufacturing the devices for their own use. With the device in successful operation, and with the master mechanic holding the patent, he has but to install one of his devices on trial on an adjoining or adjacent line and hand the officials of that line the testimonial of his employers. With the lines near home all equipped, all other lines should be solicited—preferably by a supply house or railroad supply manufacturer, who assesses a royalty on the different railroads for the use of the device, or pays a royalty direct to the owner—the inventive master mechanic.

Here is another view of the good of a master mechanic employing his inventive genius: Unlike business men, he sees little opportunity for the investment of his savings—if indeed he has anything left to save after meeting his high expenses. One of the best producers of finances for men in general is an extended use of human energy, and the employment of inventive genius is an excellent one for the master mechanic, for it does not interfere with his regular work, it benefits beyond measure the company he serves, and it will enable many master mechanics to smoke cigars in their old age instead of pipes.

In the days when the principal industry was that of grinding wheat into flour, there was a saying: "Much water goeth by the mill of which the miller knoweth not of." His facilities were crude and he did not know how to utilize the use of all the water in trying to get it to flow over an "over-shot" water wheel; at any rate, it took lots of water to operate the wheel on account of the wheel shedding it so fast or only partially using its force. So it is with the *practical experience* and *knowledge* of the master mechanic.

These are his chief worldly assets and their use may be extended by devoting some attention to inventions which mutually benefit himself and the company he serves. There never was a time when the field for inventions was so large or varied. The master mechanic who gets up one contrivance a year will have a number of them before leaving active railroad service, the income from which represents an annuity of worth.

Invent something!

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.

The International Railway General Foremen's Association held its eighth annual convention at the Hotel Sherman, Chicago, July 23-26, 1912. President F. C. Pickard presided. There were about 120 members in attendance. The regular program of the convention was distributed over four days, and consisted of the presentation of subjects pertinent to the interests of railway shop foremen and superintendents, interspersed as last year with addresses by prominent railway officials who also dealt on phases of shop superintendence. The officials who spoke before the convention were: J. F. DeVoy, assistant superintendent of motive power, Chicago, Milwaukee & St. Paul Ry., Milwaukee, Wis.; W. L. Park, vice president and general manager of the Illinois Central R. R., Chicago, and W. J. Tollerton, mechanical superintendent of the Chicago, Rock Island & Pacific Ry., Chicago. The subjects dealt with by the membership were: "How Can Shop Foremen Best Promote Efficiency?"; "Supervision Under Local Conditions"; "Shop Specialization Work and Tools"; "Roundhouse Efficiency"; "Reclaiming Scrap"; and "The Relation of Tests to Shop Efficiency."

Officers for the ensuing year were chosen as follows: For president, F. C. Pickard, master mechanic, Pere Marquette R. R., Saginaw, Mich.; first vice president, W. W. Scott, shop superintendent, Pere Marquette R. R., Saginaw, Mich.; second vice president, T. F. Griffin, general foreman, Cleveland, Cincinnati, Chicago & St. Louis R. R. Indianapolis, Ind.; third vice president, L. A. North, general foreman, Illinois Central R. R., Chicago, Ill.; fourth vice president, W. Smith, foreman, Chicago & Northwestern Ry., Fremont, Neb.; and Secretary-treasurer, Wm. Hall, general foreman, Chicago & Northwestern Ry., Winona, Minn. Members of the executive committee are: W. T. Gale, shop demonstrator, Chicago & Northwestern Ry., Chicago, chairman; C. L. Dickert, assistant master mechanic, Central of Georgia R. R., Macon, Ga.; J. S. Scheafe, engineer of tests, Illinois Central R. R., Chicago, Ill.; W. G. Reyer, general foreman locomotive department, Nashville, Chattanooga & St. Louis Ry., Nashville, Tenn., and G. H. Logan, general foreman locomotive department, Chicago & Northwestern Ry., Missouri Valley, Ia.

Among the railway supply concerns which exhibited at the convention were the following: Locomotive Improvement Co., Clinton, Ia.; Blaugas Co. of America, New York; Goldschmidt Thermit Co., New York; Chicago Pneumatic Tool Co., Chicago; Crucible Steel Co. of America, Pittsburg, Pa.; National Machinery Co., Tiffin, Ohio; Storrs Mica Co., Owego, N. Y.; Railway Age Gazette, New York; Bausch Machine Tool Co., Springfield, Mass.; Manning Maxwell & Moore, New York; Oak Grove Handle Co., Cameron, Wis.; O'Malley-Beare Valve Co., Chicago; Celfor Tool Co., Buchanan, Mich.; Skinner Chuck Co., New Britain, Conn.; Watson-Stillman Co., New York; Carborundum Co., Niagara Falls, N. Y.; American Steel Foundries, Chicago; McCord & Co., Chicago; Grip Nut Co., Chicago; Cleveland Pneumatic Tool Co., Cleveland, Ohio; American Specialty Co., Chicago; Pyle National Electric Headlight Co., Chicago; Whitman & Barnes Tool Co., Akron, Ohio; Ashton Valve Co., Boston, Mass.; Jenkins Bros. Valve Co., New York; Joseph T. Ryerson & Son, Chicago; Keystone Lubricating Co., Philadelphia, Pa.; Nathan Mfg. Co., New York; Emery Pneumatic Lubricator Co., St. Louis, Mo.; Garlock Packing Co., Palmyra, N. Y.; Hunt-Spiller Mfg. Co., Boston, Mass.; Templeton, Kenley & Co., Chicago; Cleveland Twist Drill Co., Cleveland, Ohio; H. W. Johns-Manville Co., New York; Joseph Dixon Crucible Co., Jersey City, N. J.; Railway & Locomotive Engineering, New York; Dearborn Drug & Chemical Co., Chicago; Westralian Spark Arrester Co., New York; Crerar-Adams Co., Chicago; Monarch Pneumatic Tool Co., St. Louis, Mo.; The Pilliod Co., New York; S. F. Bowser & Co., Ft. Wayne, Ind.; Greene,

Tweed & Co., New York; Ohio Injector Co., Chicago, Ill.; Locomotive Superheater Co., New York; Racine Tool & Mfg. Co., Racine, Wis.; Reed Mfg. Co., Erie, Pa.; Independent Pneumatic Tool Co., Chicago; Geometric Tool Co., New Haven, Conn.; Osborne Valve & Joint Co., Chicago.

CENTER CAB SWITCHER LOCOMOTIVE, N. Y., N. H. & H. R. R.

Included in the wholesale installation of electric switcher locomotives being made by the New York, New Haven & Hartford R. R. for its Harlem yard service, is locomotive No. 0215, shown herewith. This locomotive is somewhat different from the fifteen other switchers in that it is arranged for center cab control. The radical difference comes in that this locomotive has but one operating and controlling equipment, and this is mounted in the center of the cab. Thus the engineer has but one location in the cab for operation in either direction, the same as he would have in running a steam switcher.

This locomotive was especially arranged with master controller suspended from the roof to determine which was the best switch for shunting service; a double end control (duplicate operating and controlling equipments at each end of the cab) or center cab control (but one operating and controlling equipment mounted in the center of the cab).

The complete cab is of the "steeple type" with the control cab in the center, and two sloping end hoods protecting the control and auxiliary apparatus.

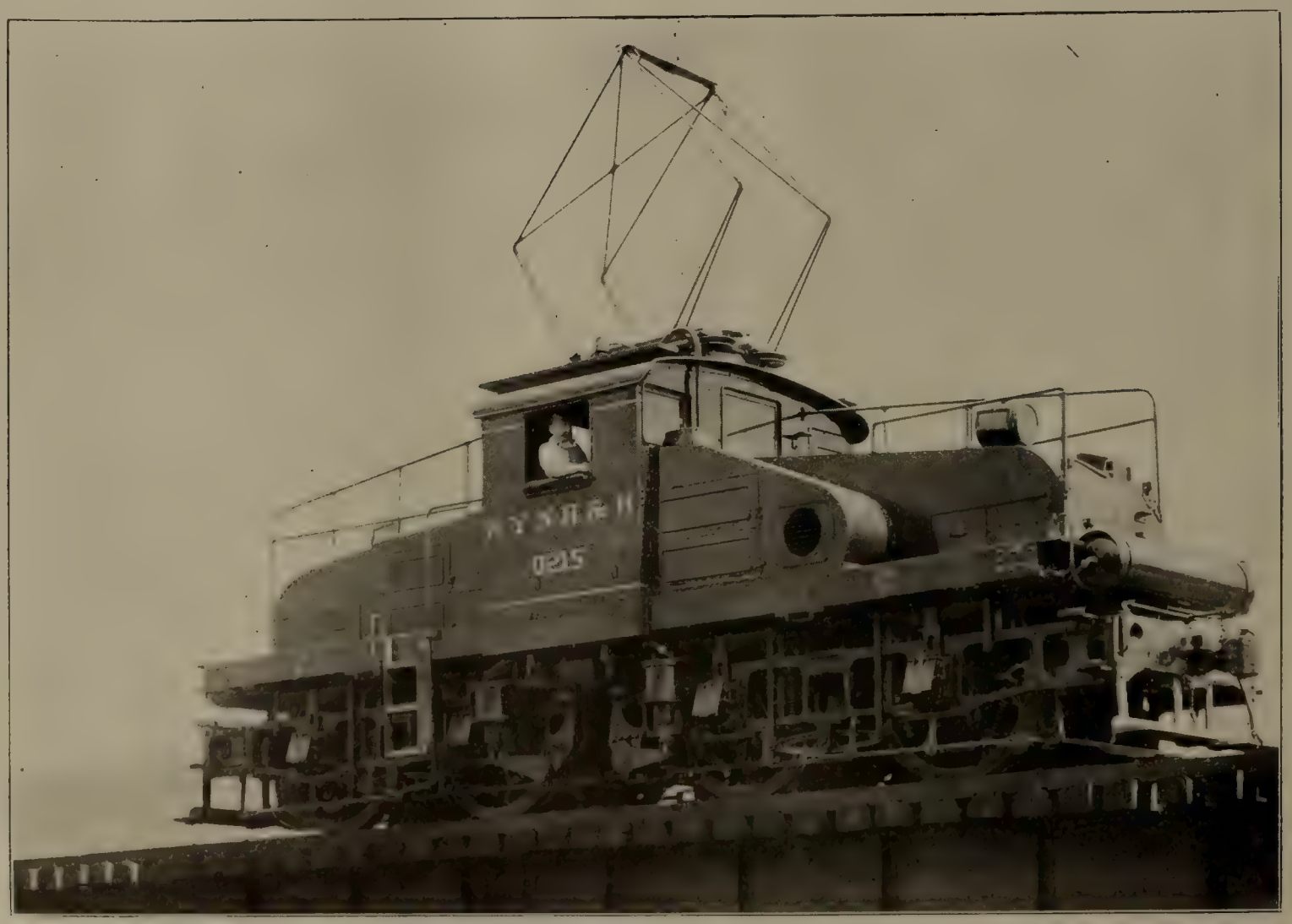
Articulated truck construction is used in this locomotive, the same as in others of this type. The frames are placed directly outside the wheels and are steel casting of the usual bar type, having the straight pedestals with removal gibs. The pulling and buffing strains are taken by the truck frames, which are joined at the center of the locomotive by a drawbar. Semi-elliptic springs are placed directly over the journal boxes, and the springs of each truck are connected to equalizing bars, but no cross-equalization is used.

For propelling this locomotive there are used four 192-horsepower, 25-cycle, single-phase, alternating current railway motors of Westinghouse manufacture. On the end of each motor armature shaft is located a pinion which meshes with a steel-rimmed gear. These gears are mounted rigidly on a quill which surrounds the axle with a clearance sufficient to allow for vertical wheel play. In the motor frame are journals formed, which carry the quills. Helical springs transmit the motor tractive effort from the gears to wheels. These springs are rigidly attached to the wheel center and gear center respectively. Thus the motors are spring-supported and the center of gravity of the locomotive is at a suitable height above the rail. A superstructure built of rolled steel shapes and plates carries the frame; the cab bolsters are of cast steel. The main driving wheels are 63 inches in diameter and have 56-inch cast steel spoke centers.

Since these locomotives are to operate only on the New Haven system, no provision has been made for operating on direct current. Thus the control equipment is very simple; it is of Westinghouse electro-pneumatic unit switch type. In this locomotive the main circuit apparatus consists of high tension oil circuit breaker, transformer, switch group, three preventive coils and two reservers.

The auxiliary control circuit, the energization of which is determined by the movement of the master controller handle, is supplied by a 20-volt storage battery. A motor-generator set is used to charge this battery. However, usually the battery floats on the line while the motor-generator supplies the control circuit, thus in case of accident to the motor-generator set the battery is ready for immediate use.

Completely equipped this locomotive weighs 154,700 pounds. The performance of this locomotive is such that exceptionally heavy loads can be hauled at an economical slow speed. It is capable of exerting a maximum tractive effort of 40,000 pounds up to six miles per hour.



Electric Switching Locomotive, N. Y., N. H. & H. R. R.

ECONOMICAL USE OF COAL.

An instruction pamphlet on the economical use of coal has been issued by the Chicago Great Western R. R. to its engine crews. This pamphlet has been carefully arranged to be of the greatest assistance to engine crews. It is extracted briefly below, by courtesy of J. J. Neuffer, superintendent of motive power:

Records.

It is the intention to keep a check on the amount of coal delivered to each engine, so that it may be known whether the right amount of fuel is being used for the work the engine has to perform.

Instructions imparted by printed pages will not necessarily make good firemen, nor is it expected that a mere knowledge of the words of these paragraphs will make a first-class fireman out of each man reading them. A fireman must have strength, patience and skill, and he must at all times exercise good judgment.

This last, though indefinite, quality of character is essential, for it does not pay this company to train a man for an engineman who cannot, in course of time, qualify for that position. An engineman must have good judgment as valuable property and many lives are in his hands when carrying out his daily duties. Nevertheless, while good judgment and ability "to keep her hot" are essential in a fireman, it is also very important that he should know something about the work he and the engineer are doing, and be able and willing to assist the latter when able to do so without neglecting his own duties. When pulling through towns or yards, he must keep a sharp lookout for signals and at all other points where it is difficult for the engineer to see, doing his firing on the straight track or when the track curves to the engineer's side.

Requirements of Engine Crews.

The first requirement of a good fireman is the ability to keep up steam with the least consumption of fuel, and a good engineman must have the ability to use the steam efficiently and economically.

Correct judgment will regulate the feeding of the fire to keep up an even steam pressure without making surplus steam to be blown away through the safety valve, or surplus heat to be counteracted by opening the fire doors to admit a great quantity of cold air into the firebox. The open door or howling "pop" simply tells of the carelessness or bad judgment of the fireman.

The fireman's first duty is to examine the fire to see that it has a good foundation for starting. The grates and connections should be examined to see that they are in good working order and properly in line, also that ash-pan is clean.

A knowledge of the laws of combustion teaches one to go direct to the correct methods of firing, and the information gained enables him to deal intelligently with the numerous character of the gases formed by the burning fuel and the proportion of air to fuel for producing the greatest degree of heat, are the principal things to be learned in the study of combustion.

The elements performing the important functions of combustion are oxygen and carbon. Combustion is a chemical combination of oxygen and carbon, but these gases cannot unite freely until they reach a certain high temperature, when they unite very rapidly in the form of light and heat.

All occupations have attractive features peculiar to themselves, and all operations connected with the management of a locomotive are fascinating to the man who is deeply interested in his work. The fireman who studies the scientific principles of his occupation finds the work much more interesting than the man who merely thinks of throwing in enough coal to keep up steam.

A man may become a fair fireman without knowing anything about the laws of combustion, but this degree of skill is only obtained by groping in the dark to find the right way.

A man who acquires his skill in this manner is not, however, a perfect master of the art of firing, and any change is likely to bewilder him and he must again find, by repeated trying, the best method. It is only the man who has given time and study to the scientific principles of combustion who can become a first-class fireman and be able quickly to find the best method to meet changing conditions.

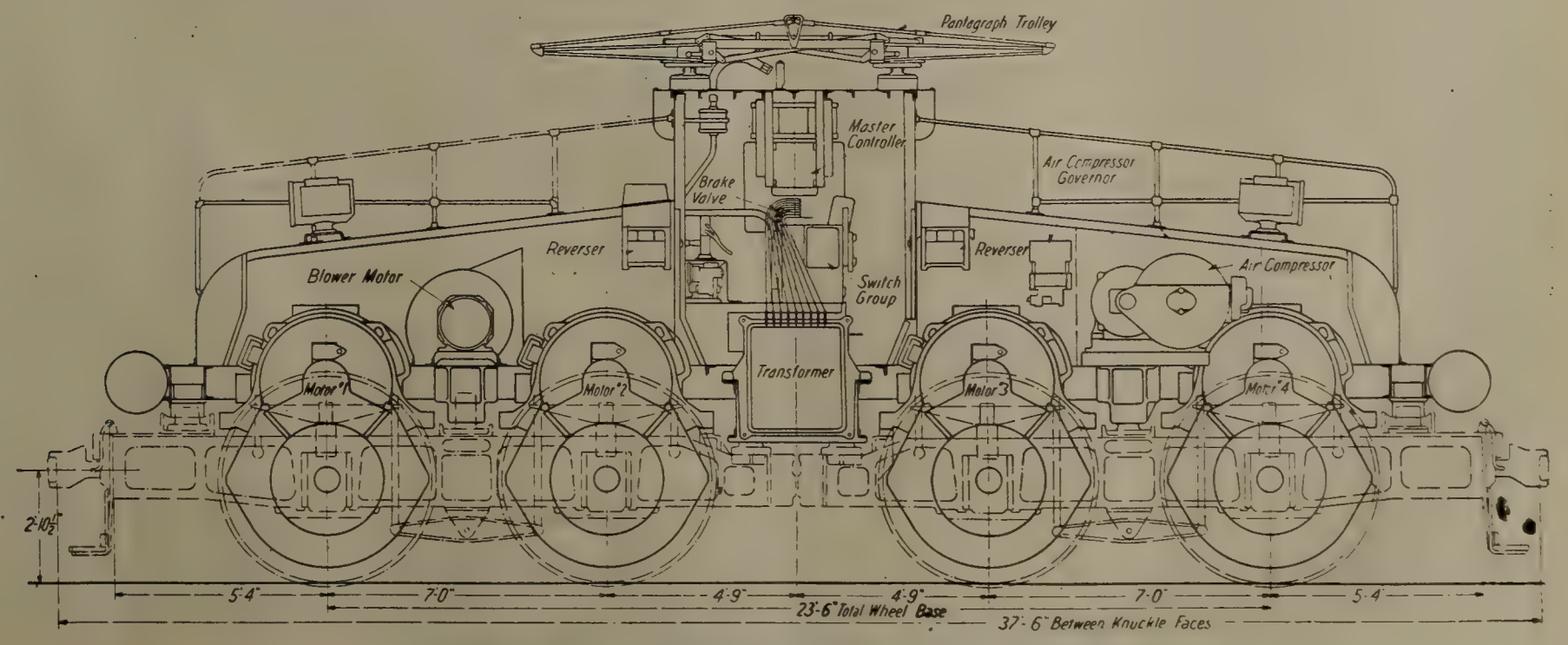
Engine Equipped for Trip.

It is hardly necessary to add that a good fireman is careful to see that there is sufficient coal and water in tender, sand in the sand box, and that the necessary firing tools and flags, lights and other signals as required by the rules, are at hand.

Care should be taken to see that not too much coal is taken; an overloaded tender simply means wasting coal by having it shaken off.

The success of a trip over a division depends very much on how the start is made. In no other line of work is it more true that "a poor beginning, makes a worse ending" and that "well begun, is half done."

A fireman with an interest in his work should reach the engine long enough before starting time to have the fire in a condition most favorable for making steam freely from



Longitudinal Section, Switching Locomotive, N. Y., N. H. & H. R. R.

the start and to perform such other duties as required by the rules.

Some firemen suppose that large quantities of water thrown on the coal aids combustion. While it may be necessary to sprinkle dry or fine coal, it should not be necessary with lumpy coal. The reason for sprinkling is that dust and small dry particles are blown through the flues after leaving the fireman's scoop without even touching the fire, or having a chance to burn, and are spouted through the stack unconsumed. Wetting keeps this fine coal on the fire until combustion has a chance to take place. Sprinkling should be done frequently so as to have a uniform effect, and it should always be done very lightly.

In preparing the fire for starting on a trip, care must be exercised to have all dead ashes and clinkers removed, and a good clean fire to a depth of about four inches over the entire grate surface.

The fire should then be built up gradually as required, considering the class of train, grade, etc. After starting on each trip, fire should be carefully watched and coal fed frequently, but in small quantities, feeding the bright spots only and keeping the fire level, except along the side sheets, where it should have a little more depth to prevent excessive draught of cold air.

Great care should also be exercised to keep a clean bright fire along the flue sheet, but fire should never be allowed to build higher than bottom row of flues.

Grates should be lightly shaken from time to time to keep a reasonable light clean fire and to avoid bringing firebox full of dirty fire to terminal, thereby causing large waste of coal when cleaning and building up new fire.

Before starting on a trip, the engineman should learn from the conductor the weight and kind of train engine is to pull, and he should give this information to the fireman.

When steam is not being kept up to the required pressure, it is the engineman's duty to find out the cause from the fireman, or at first opportunity make examination so as to see conditions personally.

Without co-operation on the part of the engineman, the work of the best fireman is made of no avail, and more coal can be wasted by the exhaust up the stack, by an engineer not keeping a watch for economical and efficient working of the locomotive, than it is possible for the fireman to save by his utmost effort and attention.

Engines must be handled carefully to see that fire is not blown or lifted off the grates by the heavy draft that is forced through them tearing holes in the fire.

When an engineman crowds the engine unduly, or "drowns" the steaming capacity with the injector full on, requiring the fireman to fire heavily in order to keep up steam pressure, the fuel record will be a poor one, and will reflect upon the engineman as well as upon the fireman.

Economical use of steam means economical use of fuel, as the quantity of steam used in the cylinders and required to be evaporated by the boiler, depends on how the engine is regulated by the engineman. When the water level in the boiler is too high, it causes priming and very wet steam.

Enginemen can do much in economy of steam by working with short cut-offs going down grade and up short light grades. Injectors should not be used while engine is standing, if proper water level is secured before stop is made. At all times, however, when engine is working, with fire in good condition and steaming freely, with full pressure, injector should be kept on sufficiently to supply steam needs from boiler. When necessary to inject water into boiler with engine standing, it should be done gradually.

A general rule applying to all engines is that when a start is made, either from a station or out of a terminal, the fire should be in such condition that it does not at once need more coal.

Coal properly broken gives better combustion and helps prevent the forming of clinkers.

The early preparation of the fire and coal for the trip is not in any sense extra work, but the reverse, as this attention secures the best fire.

When the train is ready to start, there should be a glowing fire on the grates sufficient to keep up steam until the reverse lever is notched back and the exertion of starting is over.

At such time it may be necessary to have fire door on latch, to avoid danger of a too strong draft through the fire or to secure an ample supply of air above the fire to consume gases; at the same time, care must be taken that door is not wide open at long intervals, permitting large amounts of cold air to rush into the fire box and flues, cooling the gases and causing severe strains on the fire box sheets and flues, resulting in a waste of fuel and leakage.

When the time for replenishment of the fire arrives, a good fireman knows both from instruction and observation that the effect of throwing fresh coal into the burning mass in the fire box is similar to that of pouring a dipperful of cold water into a kettle of boiling water. If a large quantity of fresh or green coal is thrown into the fire at one time, it cools the fire, and tends to depress the temperature of the burning mass for a brief time, below the igniting point, so that large volumes of gas in the form of smoke or unconsumed fuel mixed with half heated air pass through the flues, doing little or no good in heating the boiler, wasting heat and good fuel, besides making black smoke. Use only two or three scoopfuls at a time, scattered well over the surface, where needed. This small charge of coal will intermix with the already glowing fire and will not cool it appreciably.

A fireman is known by the color of his smoke, which is light as his firing is light and frequent, and is black and heavy as his fire is the same.

Should indications show that the fire is not receiving sufficient air through the grates, the fireman gently shakes the grate, an operation which is repeated during the trip at intervals sufficient to keep the fire as clean as possible. The grates should not be shaken violently or frequently, as this disturbs the fire unnecessarily, and must be avoided when engine is working hard; holes are made in the fire and much fuel wasted.

Good coal requires no more grate shaking than will prevent clinkers from hardening between the grate openings. Coal that contains much ash will be burned to greater advantage when the grates are shaken lightly and frequently and the shaking done by short, quick jerks. A long slow movement in shaking grates merely moves the clinkers resting upon them.

Shaking grates are designed to be used for the breaking of the clinker, so that it will fall into the ash pan and permit dead ashes being cleaned out while good fire remains above. Care must be taken that grates are properly in line after each shaking.

The fireman should never attempt to handle all the coal he can scoop upon a shovel. The objections to doing so are:

1. A great waste of coal, as some of this fuel will roll off shovel before he delivers it to the firebox.

2. He cannot properly scatter a large scoop of coal. It is well to take just an even full scoop and when delivering it, he should so manipulate the scoop as to spread this coal, when it alights on the surface of the fire.

A good time to economize on fuel is after going up over a grade and starting down hill. Firemen will sometimes fire very hard just before reaching the top of the hill, covering the fire over completely with a fresh bed of fuel, and leave this fire to burn up without further attention on the down grade.

As a rule, this extra firing just before reaching the top of the hill is unnecessary, and it is better to keep the fire in good condition by an occasional scoopful scattered well over the fire, even on the down grade when very little steam is used; always, of course, keeping a bright fire at the flue sheet.

It is important that a uniform steam pressure be maintained. A safe water level must also be maintained at all times. It will, however, often be found possible to vary the water level within reasonable limits, in the interests of uniform steam pressure and fuel economy.

The blower and steam jets must be used only when necessary. They must be used as lightly as possible and no longer than necessary to effect the desired purpose. The fireman should keep familiar with conditions during the trip, read the orders, learn not only the schedule of the train he is on, but other trains as well, so as to know all the stops and be familiar with all the grades, etc., on the division. In this way, he can anticipate the work to be done by the engine and prepare his fire accordingly.

The engine should be left at the terminal with a full glass of water, a bright fire and a good steam pressure.

Smoke-Abating Devices.

The use of arches in the firebox of locomotives covers a period of a good many years, but its use has been rather spasmodic. During the past few years the arch, having been studied closer, has come into more general use. In this period of study, several styles of arches have been developed, each having its good points and some going back to the first or early designs.

On the Chicago Great Western, we are using two styles of arches, as follows:

The hollow arch used on engines with long, wide or narrow and medium depth of firebox. The arch is supported on a number of water tubes, and has a number of air tubes opening at the back end or top. It is carried back toward the fire door and up toward the crown sheet until it reaches a point where the area between the arch and crown sheet is the same, or a little greater, than the area of the tubes, and the top or back end is above the top of the fire door.

The air is brought through the throat sheet by means of a number of 2 inch tubes and is connected to the air tubes in the arch. The air in passing through the arch is heated to a high temperature, and is discharged at the back end, where it mixes with and furnishes oxygen for the combustion of the gases as they pass over the arch to the tubes.

The vertical arch is used in long and shallow, wide or narrow fireboxes. It is supported on a cross brace secured to the sides of the mud ring. The arch is located about 20 inches from the flue sheet, thus forming a combustion chamber between the flue sheet and arch. It is carried vertically up to a point where the area between the top of the arch and the underside of the crown sheet is the same, or a little greater, than area of the tubes, and also above the top of the fire door. It is also equipped with a number of air tubes which open toward the fire near the top and are carried out in front of the ash pan. By means of these openings, air is delivered at a point where it mixes with and furnishes oxygen for the combustion of the gases as they pass to the combustion chamber.

In burning coal, several kinds of gases are generated, which we will divide into two general classes, one visible and the other invisible.

The invisible gases are called gases of perfect combustion. The visible are called gases of imperfect combustion.

There are also fine particles of carbon held in suspension of these visible gases which, escaping from the stack, we call smoke. These gases, of imperfect combustion and carbon held in suspension, are rich in heat units; but they require high temperature and a large per cent of oxygen in order to consume them.

By use of the arch, we obtain the high temperature and with the air tubes the oxygen is delivered to the firebox; and we thus are enabled to save a large amount of heat units that would otherwise be lost, and at the same time the amount of smoke is reduced and a more even temperature is maintained in the firebox.

The baffle fire door dates back some years for its origin, and has been used more or less, but not very generally. The door operates directly opposite to the ordinary or the pneumatic doors now in use, in that it swings inward and upward. The purpose of this being the deflection of the inrush of cold air in a downward direction, where it mixes with the hot gases, and assists in reducing the black smoke, and when used in connection with either of the arches above described, the black smoke is practically eliminated when the engine is working.

The double blower is the result of experiments on different railroads. The construction is simple, being made up of 1¼ inch pipe arranged with two blower tips, which instead of being drawn down to a round tip, are flattened down to ¼ inch wide by 1¾ inches long. These tips are located at the base of the stack, one on either side, and on an angle so that the steam escaping from the tips will intersect each other at a point 18 inches from the base. This blower has proven very successful in reducing the amount of black smoke when the engine is standing or drifting.

Fire box steam jets consist of a number of 2 inch tubes extending through the water space, located on each side 14 inches above the grate on wide fire boxes, and in the most convenient place to clear the spring equalizer on narrow fireboxes. On the outside a steam jet, $\frac{3}{16}$ inch in diameter, is placed in the center and flush with the edge of the tube, the object being to force the greatest amount of air possible through the tube into the firebox, where it mixes with the gases, and assists in causing a draft, when the engine is standing or drifting.

By using the double blower and steam jets when an engine is standing or drifting, a draft is created, and the air from the jets mixing with the gases in the fire box, consumes a portion of the visible gases and carbon held in suspension, with the result that no black smoke escapes from the stack.

A Few Don'ts For Firemen.

DON'T "slug." One scoopful each minute being preferable to a number of scoopfuls at intervals of several minutes, as the fire is kept in a more uniformly good and smokeless condition.

DON'T fire aimlessly. Like a baseball pitcher, a fireman knows in his mind's eye on just what spot he is going to land the next shot.

DON'T think that the water glass is for the engineer only. A close and intelligent watch on the water level will help toward a more economical use of fuel.

DON'T have safety valves open. On an engine carrying 200 lbs. pressure, there is a loss of one scoop of coal, or 15 lbs. every minute.

DON'T fire coal on top of coal. It will not burn and will cause a "bank."

DON'T put large lumps in firebox. They will sink through the fire to grate and may start a clinker.

DON'T leave fire door wide open when engine is working hard. Large quantities of cold air are drawn in, causing a severe strain on firebox sheets and flues.

DON'T allow banks in the fire, as this will cause a stronger draft through the thinner parts of fire and tear holes in it.

DON'T make too free a use of rake or shaker bar.

DON'T shake grates when engine is working hard.

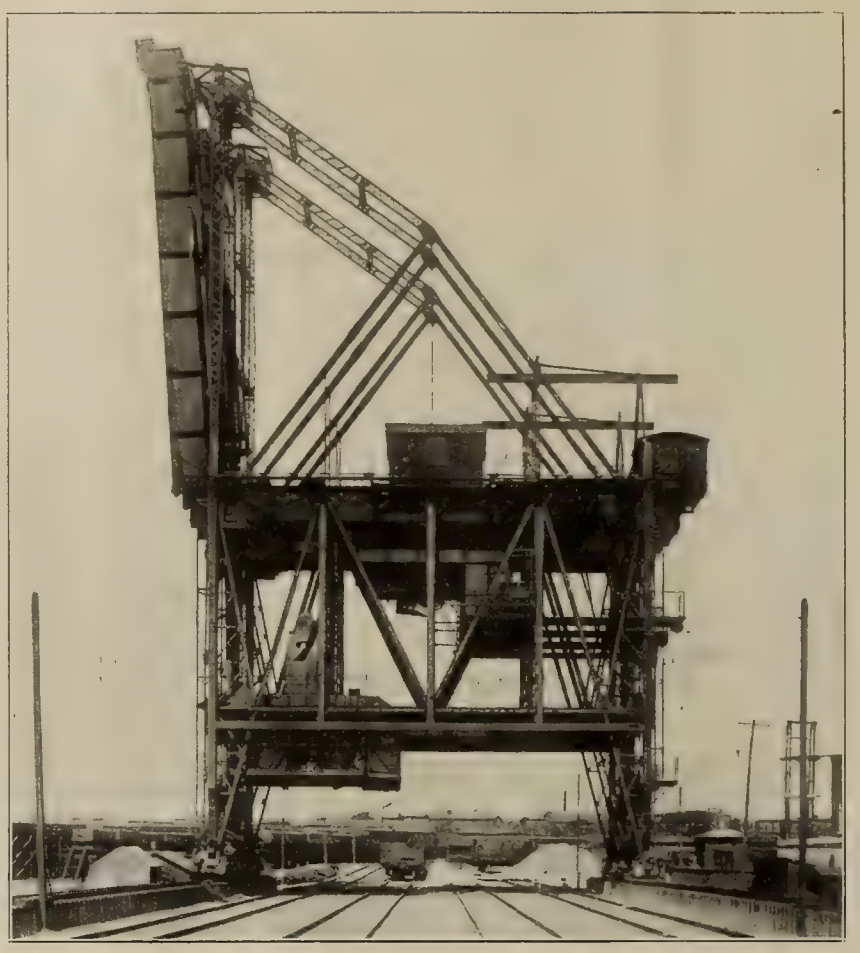
ORE HANDLING PLANT, PHILADELPHIA & READING RY.

An ore handling plant has been installed at Port Richmond, Philadelphia, by the Philadelphia and Reading Ry. for unloading the ore from the vessels as they lie at the dock.

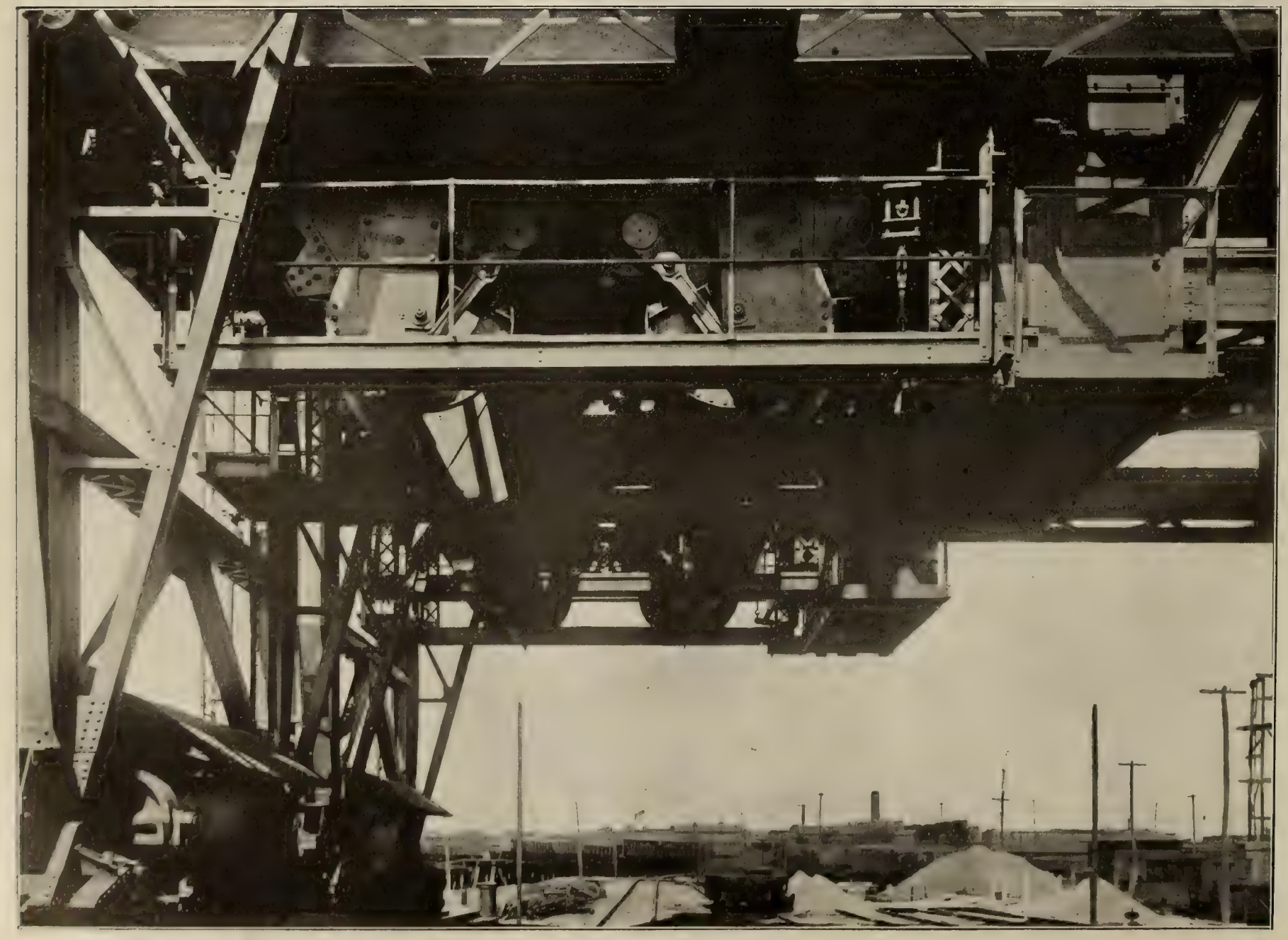
Ore is brought there principally from Newfoundland, Norway, Sweden and Cuba, and distributed from this point to the various steel plants throughout the country. The ore brought in is of an unusually high grade, ranging in many cases from 85 to 90 per cent.

The installation is unique among ore handling plants in which, of course, the lead is always intermittent, in that no auxiliary devices whatever are used for maintaining the voltage, constant through varying leads, the inherent regulation of the machines being so entirely satisfactory that none are required. In most plants of this kind fly wheels equalize sets with automatic regulation, or some device of a similar nature is usually employed to reduce the variable load to an average value, but in this case no such devices are used and the voltage variation is only from three to four volts with a range in lead on the rotaries from 2,000 to 2,700 amperes.

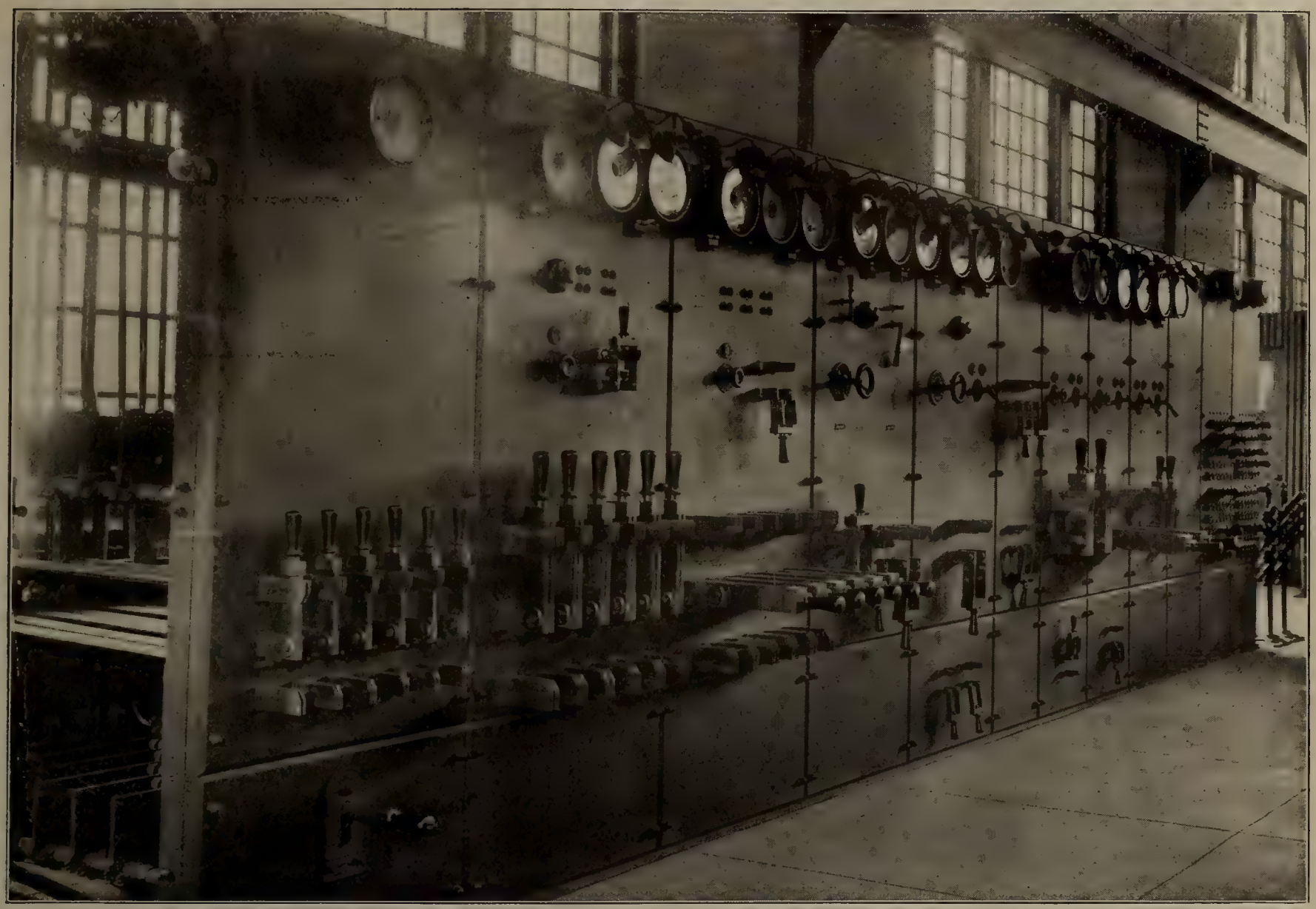
After considerable investigation of the problem it was decided that the best system to install, considering it from all sides, was steam turbine alternators and rotary converters. A small plant located about one and one-half miles distant from the main power station had to be operated also; therefore, alternating current was selected so it could be transmitted readily to the smaller plant, using transformers at both the generating and receiving ends.



Ore Handling Plant, P. & R. Ry.



60-Ton Weighing Hoppers, P. & R. Ore Plant.



Front View, Black Enamel Slate Switch Board.

The generating equipment of the power house consists of two 1,000 kva. Westinghouse-Parsons steam turbines, generating six phase, 60-cycle alternating current at 178 volts, at which voltage it is delivered to two 750 kw., six-phase, 60-cycle Westinghouse rotary converters one of which is shown in Fig. 4 (46750), delivering direct-current to the switchboard at 250 volts, thus forming two complete units.

Excitation for the turbo-alternators is furnished by a 48 kilowatt, 125-volt generator direct-connected to a 9½ in. x 9 in. standard Westinghouse engine. A 125 kw. three-wire direct-current generator is also used to supply exciting current and for lighting the building which is arranged for three wire distribution.

There are also four small arc machines belted to high speed steam engines for furnishing light to the grounds and docks.

The switchboard consists of 12 panels of black enameled slate. The switchboard has a double set of bus-bars so that the load can be carried on either set of machines. The first panel on the left when facing the board has mounted thereon an ammeter and an oil switch for the circuit leading to what is known as the Clearfield Street sub-station mentioned above. There are also six single-pole double-throw knife switches mounted on this panel for controlling the circuit on the generator side of the step up transformers.

Next on the right are the two generator panels each containing an ammeter, a wattmeter, a field ammeter and switch, rheostats, voltmeter and ground detector switches, and six single-pole double-throw knife blade switches for the generator.

The two exciter panels, one for the 48 kw. two-wire and one for the 125 kw. three-wire machine contain the usual equipment of meters and switches including one for the balancer coils on the three wire machine. A small panel is placed next to the exciter panels for taking care of the three-wire lighting system.

The two rotary-converter panels each contain a direct-current voltmeter and ammeter, rheostat, field switch, two single-pole, single throw 4,500-ampere knife switches and control switches for two single pole Westinghouse remote control electrically operated type CA carbon break circuit-breakers which are located in the basement. The distribution to the ore handling and car haulage equipment is made from the panel adjacent to the rotary panels, containing ammeters, switches and control switches for electrically operated carbon circuit-breakers.

A blank panel and two panels for the control of the various arc lighting circuits throughout the buildings and grounds complete the board.

Two Westinghouse-Leblanc condensers are used in connection with the turbines and produce a vacuum of from 29 to 30 inches when operating under normal conditions.

A ten ton hand-operated crane installed in the engine room greatly facilitates the handling of the machinery.

The engine room is unusually large and well lighted, affording plenty of space for attending to the various machines.

The sub-station referred to above, is located at Clearfield Street and Delaware River, about one and one-half miles from the generating station and contains one 200 kw. rotary with step-down transformers and switchboard. The current is used for operating a smaller orehandling plant. The voltage is stepped up at the generating plant to 2,200 at which it is transmitted to the sub-station where it is stepped down to the rotary voltage.

By this system a highly efficient plant with a minimum amount of attendance is maintained in a most economical manner.

Two Brown Hoisting Machinery Co. electric fast plants with 60-ton weighing hoppers, are used in unloading the ore from the vessels as they lie at their docks to the railroad cars on their tracks as shown. The hoppers drop down into the hold of the vessel, scoop up the ore and are then raised up and carried over the railroad cars into which the ore is let fall.

The plant has been in operation for several months now and the satisfaction received seems to be a full justification of the selection of this system. Particularly noticeable is, as mentioned before, the very small voltage variation through wide ranges of load, this minimum being attained only through the inherent regulation of the turbines, and rotaries and not through any eternal voltage regulating device.

The turbo-generators, rotary converters and switchboards with electrically operated circuit-breakers were furnished by the Westinghouse Electric & Manufacturing Company, and the condensers by the Westinghouse Machine Company of East Pittsburgh, Pa., and the ore handling equipment by the Brown Hoisting Machinery Co., of Cleveland, Ohio.

Rear View of Switchboard Showing Wiring Arrangement

CAR SHOP APPRENTICES.*

By I. S. Downing.

The recruiting of workmen in the car department has not been given the consideration in the past that it should. The apprentice system is a very good plan if we could get the boy to enter the car department, but in order to get the boys to take up car-department work we must be able to show them some inducement, either in mechanics' rates of pay or a line of promotion. There is no real reason why we should not be able to establish rates which would be sufficient to induce the boys to take up car-department work, without filling their heads full of the idea that some day they will be general managers or superintendents of motive power.

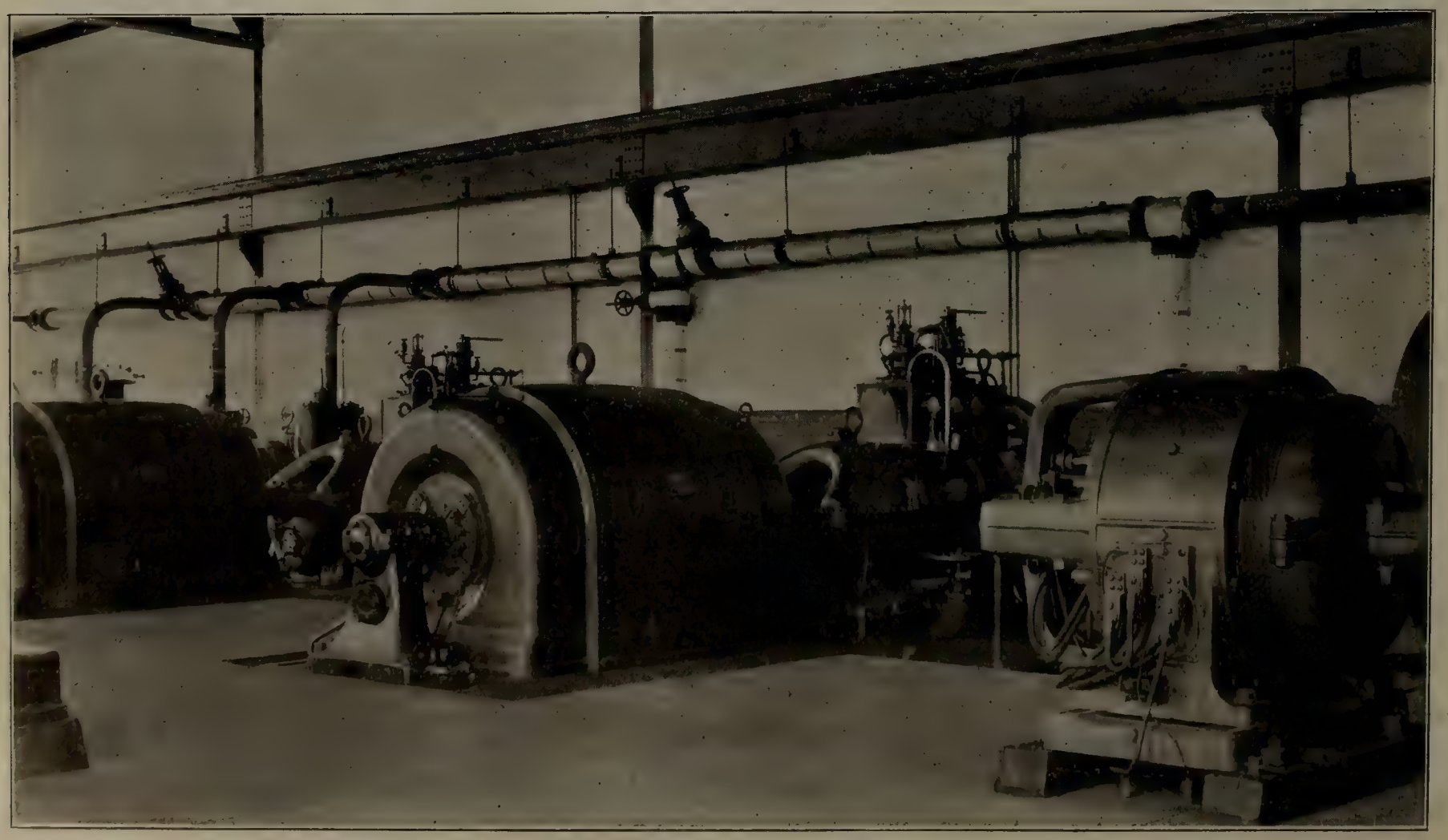
First let us consider what we have to encourage the boys to take up car-department work. The trades we teach the boys are not trades that can be applied generally, and for that reason we should classify them railroad trades.

The upholsterer trade in car shops consists of upholstering seat backs and cushions and the tieing of a few mattresses. Tufted work is seldom, if ever, done. What can the apprentice do after he has learned this trade in a railroad shop? He can only follow upholstering in railroad shops; if he goes to furniture factories or any other commercial concern he will have to learn the trade over.

The above is also true of the tinners' trade. Railways purchase practically all tinware, and steel cars have eliminated a great deal of the tinners' work.

The painters' trade is taught more thoroughly, but the work is specialized, and I have known men to do nothing but varnish for ten years.

*A paper read before the Master Car Builders' Assn., June 14, 1912.



Interior of Power House, Turbo Generators in the Foreground, P. & R. Ore Handling Plant.

With reference to cabinetmakers—it is my opinion that the steel car will eliminate the cabinetmakers and carpenters entirely. These two trades were the most important trades in the car department and required a great many years to learn. With conversion from wood to steel, the work in these departments will be less complicated, the finish and other parts being machine work and will be ready to apply when received in the shop. Very little time will be required to teach the men how to remove and apply the various steel parts. It will necessarily follow that the cabinetmaker and carpenter will be converted into steel-car men.

The parents of the boys, as well as the boys themselves, are questioning the advisability of taking up these trades in the car department, and for the above reason, also that the remuneration is below mechanics in other departments, we have a great deal of trouble getting young men to take up car-department work.

It must be admitted that the car department has not the technically trained men that other departments have, and that the car-department salaries are not as attractive as the other departments. It must be admitted by car-department heads that the locomotive department requires more men with technical knowledge than the car department. This is true at least so far as shops are concerned, but I will not admit that there is more executive ability required to manage the locomotive department than the car department. Training men for car departments to-day—the trades are of small consideration compared with other duties. The head of the car department today is an operating officer as well as a car builder; he comes in contact with shippers and other railroad officials and co-operates with officials in all departments on his own line. This the locomotive man does not do, except with his own line. A narrow-gauged car man can lose more business in one day than the freight department could solicit in a month.

I do not agree with car-department men that the line of promotion for the head of the car department should be to superintendent of motive power. It is true some car-department men have been promoted to superintendents of motive power and have been successful; however, it was not due to the car-department training. I will also have to disagree with car-department men that the two departments should be separated, the car department being on an equal basis with the head of the locomotive department. There is too much in common with both departments to separate, and they should be under one head. It would be very encouraging to car-department men if they were considered for promotion through the transportation department. There is no reason why a division general foreman or general car inspector would not be able to fill the position of trainmaster and master car builder as assistant superintendent, and if he knew his line of promotion was in that direction it would not be difficult for him to fit himself for that line of work, as he follows the operation of trains the same as the trainmaster. We need trained men for what we have to do, and the apprenticeship system is as good a recruiting scheme as I could suggest to supply the shop with trained workmen, but with the inducements we have to offer we do not seem to be able to get the boys—they want to go into the locomotive department, and we get what is left.

In view of the facts stated, relative to the different trades, remuneration and the absence of line of promotion higher than the head of the car department, it is a question, unless some radical changes are made, whether the recruiting of workmen through the apprentice system is superior to the old helper system.

Discussion.

F. W. Brazier: I have been a car man for 38 years and I want to say that the car department is the department of the future. The motive power man will be laid on the shelf in ten years and the car men will be ahead, for in ten years motive power will be electrically driven. The paper is good but there are some things with which I don't agree. I do not believe in having the two departments under one head. I think the car department should come under the general manager, for the car department man spends more money. My road spends each year $12,000,000 in the car department to $8,000,000 in the locomotive department. A car foreman yearly handles material worth $500,000, but still we are often unsuccessful in getting his pay raised to $90 a month, while a master mechanic with a small number of men under him would get $200 per month. Of course, many locomotive men have the harder job, as for instance, the average roundhouse foreman. I think the apprentices in the car department have just as good a chance to advance as those in the locomotive department.

I'm a motive power man myself and served my time as an apprentice in that department. Then I entered the car department at 20 cents an hour. Electricity is the coming thing and I think that George Wildin will soon be superintendent of electricity. I am proud to be a car builder and proud to wear this badge as a past-president of this association.

Mr. Brazier then read a poem on the Master Car Builders, which is as follows:

Forty-five years have passed away,
Since the first Convention of the car builders of that day.
It was in the year of Eighteen sixty-seven,
Many who attended that time are now on the honor roll of Heaven.

Van Houten, Garey and McWood,
We mention these names thinking of the good
That these noble men have done in the past.
Surely as a monument it will last.

Good old veteran John Kirby is living to-day,
To show the young car builders that car men live alway.

Grand old Marden, Grieves and Lentz,
You always found them good old car men, on the right side of the fence.

Hennessey, the man we love so well,
We hope many years with us he will dwell.
Crone, Schroyer, Fowler and Chamberlain,
Names known from Maine to Spain.

Dow, McKenna, Buker and Appleyard,
Were Master Car Builders of the right card.
Don't tell me the Car Department is dead,
When we can have such men to stand at the head.

The Master Car Builder may be called by another name,
But you will find the men who build your cars will be car builders just the same.
The Rules of Interchange made by Master Car Builders in the past
Brought peace and harmony to all the railroads at last.
No other organization ever can
Do the good that has been done by the car man.

Young men in the Car Department go,
The future is bright as the shining snow,
Your chance is as good as other men
If on your loyalty and work you depend.

The steam locomotives soon will be a thing of the past.
Electric Power will come at last.
You can be an electrician as well as a steam man
Bright is the future of the good car man.

C. A. Schroyer: Now you will know there is something in the car department. It is to be regretted that more young men do not enter this department but the boy of today who enters it will stay on one job such as repairing trucks. We must give that boy a general knowledge or we will not have men in the future to head our car departments. The tendency today is to have men work for themselves instead of for the company. The tendency is to specialize and work piece-work. When a good man is found for a place, the tendency is to keep him there. I know a man on the St. Paul who would be at the head of the department if he wasn't too good a car man. Young men these days want to start at the top and get the most money at once. I started at 18 cents a day. Then I quit a job at $2.50 a day and took one at $1.50. Then I entered service on the Pennsylvania and they gave me a chance there. Today they want to know what you are going to pay; they want to know what you are going to give before letting you know what they have to give.

J. J. Tatum: I want to second Mr. Brazier—there is an opportunity in the car department for young men. I started 33 years ago on the Baltimore & Ohio, the road that had the first locomotive, the first air-brake and the first telegraph. I started as a messenger boy and finally helped to build locomotives and cars. We want to place at the head of the department a man who has been trained from apprenticeship up; we want to give the apprentice a chance.

Henry La Rue: I am not old enough to give experiences like the rest, but I want to say a word as regards remuneration of apprentices. The rules for machinists should not apply to the car department. We should keep our eye on the men doing piecework as the ones who demonstrate ability should be promoted. Usually after a man has been an apprentice for a while he wants to quit. We will have to select future car men by personal selection.

J. F. De Voy: The Chicago, Milwaukee & St. Paul offers the same advantages to apprentices in the car department as in other trades. A machinist in the car department must be just as skillful as one in the steam line. A blacksmith's apprentice must have skill in making dies. In the upholstering work we don't use as many apprentices but we give them attention. The older members need not feel alarmed as the responsibilities of the car men will always be as heavy or heavier than those of the locomotive men. It is to be regretted that there are not over 25 car men in the United States today, but the time will never come when the tail will wag the dog. We have got to have men who can impress their superior officers as to what can be done in repairing cars.

J. J. Hennessey: I feel that the car men are on the firing line and have not much more time to serve. Why are we not getting more bright young men in the car department? Few car men today advise their sons to go into the car department, because there is not as much money to be earned in that department. On the St. Paul, apprentices get the same pay for the first four years, but after that the car men get 30 to 32 cents an hour, while the locomotive men get 40 to 45 cents an hour. We must offer better inducements for men to enter the car department. Some insinuate that the car department is not a mechanical department but no man can become a thorough car man in the same time that it takes him to become thorough in other departments.

M. K. Barnum: I think there is a separate field for the car apprentice. I do not think he should be a cabinetmaker, etc., but should be given a chance to learn the entire business of the department. Before starting he should see the schedule of what he is to learn. Such a schedule should embrace everything in the car department. I do not think that the life of a cabinetmaker will be as short as the writer of the paper seems to think. I believe that the interior of the future passenger car will be of wood. I do not think we should separate the departments, but the car department organization should be given more prominence. It is getting difficult to find men for the higher positions, for the supply men are drawing strongly on the car department. I am tempted to criticize Mr. Brazier with regard to the life of the steam locomotive, although I think that electricity in the operation of steam roads is bound to increase rapidly.

INTERNAL COMBUSTION ENGINE AS A RAILWAY MOTIVE POWER.*

By W. R. McKeen.

The internal combustion engine is ordinarily considered a late invention and yet it seems to be older in principle than the steam engine. We have a record of an internal combustion engine using gun powder as a fuel, as far back as 1678. In the 1880's the internal combustion engine was developing rapidly and its practical use was recognized. Useful practical development in the gasoline engine dates back not much over twenty years.

However, the internal combustion engine has demonstrated its fitness, economy and practicability for so many difficult power-absorbing mechanisms; why not for railroad purpose? A great many mechanical devices are to-day made possible and practical by the internal combustion engine and by this form of engine alone. Its remarkable efficiency, its remarkable proportion of horsepower developed per pound of weight, its reliability of performance, make it a prime mover, when rightly appreciated, far superior to any other form of power-generating apparatus. One of its chief characteristics is its reliability of performance and simplicity.

On account of commercialism, of the enormous profits made by the extraordinary high rate of introduction of the internal combustion engine into general use, we naturally have many failures attributed to the internal combustion engine which are not attributable to the principle of this engine, but simply to the imperfect workmanship, the carelessness in manufacturing, the lack of comprehensive thought in the design, the lack of proper and well-established precautions against failure. The electric wiring on the ordinary gasoline engine is not up to the standard of ordinary dwelling wiring. Precautions against failure from this wiring are given less consideration on a gasoline engine than those against failure from almost any other kind of wiring in the country.

A large internal-combustion-engine-propelled sea-going battleship, smokeless, stackless, coalless, almost submerged, to outclass the most modern of dreadnoughts, is being built. It is only in 1905 that a gasoline-propelled 600 horsepower torpedo boat, built in America, was the first internal-combustion-engine-propelled craft to cross the Atlantic Ocean.

The internal combustion engine in automobile service has demonstrated its supremacy over all other kinds of power, and in this business the highest developed steam engine machinery known to man, has given way to the internal combustion engine.

In the study of the internal combustion engine one is struck with the remarkable accuracy of logical sequence of events in the performance of this mechanism. From this observation and others, the possibilities of increasing the remarkable economy and reliability of this form of power in the future is assured.

In studying the smoke abatement in the electrification of railway terminals in Chicago some very interesting observations were made in discussing "What is smoke; what is an internal combustion engine; what is the principle involved; what do you mean and how is the power generated; why is the internal combustion engine destined to replace coal burning boiler generating steam engine power plants?"

In burning coal under boilers the heat units—in the form of energy—are transformed into a certain number of cubic inches of steam and stored under pressure in a boiler; this steam pressure, this large storage of energy is easily utilized, is convenient and comfortably simple in its action. On the opening of a throttle the steam under pressure forces its way promptly to the cylinders and the stored power from the boiler is immediately transferred to the piston in the cylinders. The amount of power is immediately under the operator's control. The power transformed is a direct function of the pressure and quantity or number of cubic inches of steam transferred.

The internal combustion engine is much more simple in its operation if properly understood. The transformation, however, is made in the engine, by the engine itself. Instead of the cubic inches of steam being forced into the cylinders, a mixture of air and gasoline vapor is sucked into the cylinders by the piston. It is true the power cannot be efficiently obtained until this mixture is to a greater or less degree compressed, which is done on the up-stroke of the piston. Then by an electric spark this compressed mixture is immediately transformed into a pressure-and-power-giving medium.

My theory propounded several years ago was that, with a reasonably good carburetor adjusted, there was no reason why a gasoline engine should not be furnished with a reasonably good mixture of gasoline vapor and air under all conditions. It was simply a question of design and could be obtained beyond any doubt; furthermore, whether the engine ran slow or ran fast, whether it ran on a cold day or on a hot day, if this mixture was furnished to the internal combustion engine cylinder, partially compressed, and if we had a spark in that cylinder, the power was bound to be there. The question was, then, to know that the mixture and spark were there.

I found that in the use of internal combustion engines in the world at large many complaints of that engine arose from the fact that the operator did not know whether or not he had a spark inside the cylinder when it should be there. Ways and means of putting the spark there have been well developed and exist to-day. The only thing necessary was to surround this sparking device with suitable practical safeguards to avoid its being disturbed or overburdened or put out of commission through ignorance, accident, etc. This protection being worked out, the spark in the cylinder is assured (and as a matter of fact) the internal combustion engine becomes just as positive, just as reliable as any steam engine and more practical in its performance.

When one reflects upon the careful thought given by the brainiest men to the steam engine for a century and more and thinks of the close attention that is given by experts to the care of the steam engine to-day, whether stationary or otherwise, thinks, that is, of the work on the steam engines that must be done by mechanics of different types, for the proper maintenance of those engines, and then compares this to the lack of intelligent supervision given to internal combustion engines, considering the days, months and years that internal combustion engines sometimes run, without any expert inspection or any attention whatever, noting the wonderful performance day in and day out of the internal combustion engine of automobiles, handled by women, children and men of all walks of life and the cars attended to by men that scarcely know the difference between gasoline and coal oil; the comparison alone is conclusive as to the future of the internal combustion engine. The introduction of internal combustion engines into general use has been so rapid that they necessarily have had to be handled and looked after by people not familiar with machinery and not familiar with the workings of the same. Men experienced in handling internal combustion engines could not be developed fast enough to look after the product, notwithstanding that information in handling the internal combustion engine has probably spread more rapidly than information on any other kind of power.

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*From an address delivered before the Committee on Smoke Abatement and Electrification of Terminals, Chicago Association of Commerce.

A well-developed design of electric motor under many conditions gives good service day in and day out without any great amount of trouble, and yet there are danger lines —a little undue moisture, a little undue heat, a little neglect of the proper lubricant to the armature shaft, and the whole apparatus is out of commission and repairs made very complicated; but the internal combustion engine stands all kinds of abuse and yet will keep running. I have seen internal combustion engines give regular service every day, making many miles, under conditions that really to all human comprehension would have seemed impossible. I have in my personal experience observed gasoline engines running for a year at a time without ever opening the crank case; without ever making an opening to the cylinder; and without ever making an adjustment on the prime mover as a mechanism itself; and these same engines at the expiration of a year were in good condition. The only human attention they had received whatsoever was the furnishing of the supply of gasoline for the carburetor and oil for the lubricator.

As a stationary proposition I do not believe anybody will question the reliability, practicability and economy of an electric motor, a steam engine or an internal combustion engine.

Power Transmission.

In electric traction equipment the electric motor runs normally at a very high speed, and a reduction of this speed in the transmission of power to the driving wheels is done through gears. This gear transmission alone entails a loss of from 12 to 20 per cent of the power developed by the motor. These gears wear very rapidly and are noisy. While they are reasonably efficient when the gear teeth are of the proper shape and new, as soon as they wear the loss from same increases rapidly.

The steam locomotive transmits its power to the driving wheels from the cylinders through a system of guides, crossheads and rods. This is a well developed transmission power and the parts are well worked out from long experience and yet there is more or less breakage. This transmission requires constant inspection and attention. In ordinary freight service the power used to drive the locomotive and tender and to overcome the friction of the mechanism is from 15 to 35 per cent of the total power developed in steam cylinders. The internal friction alone of a locomotive varies from 12 to 20 per cent; safe to say with an ordinary freight engine, partially worn, most of the time it will run much over 20 per cent. The counter-balance of the large modern type locomotive becomes a very severe tax on the track and road-bed, particularly in the high speed.

The application of the steam power and electric power to transportation mediums has been well established; the application of the internal combustion engine to railroad mediums is in its infancy, but when you consider the economy possible with the internal combustion engine the future extensive use of this form of power is readily appreciated. For a single unit or car proposition we have the prime mover, the internal combustion engine, and by the ordinary practice, the power from same is transmitted to driving wheels by a chain; using the frictionless chain, the chain pins are knife edges working on each other; the power from the generator can be transformed from the crank shaft to the periphery of the driving wheels with a loss of 3 to 4 per cent when direct-connected. Primarily the internal combustion engine must work direct-connected at least 90 to 95 per cent of the time; therefore the large economies with this form of power are obtained at this large percentage of the hours worked, making same particularly attractive.

The only complication in the use of this power is in its original application to the load. But with a friction clutch interposed between the prime mover and the driving wheels, which is a simple proposition, and a gear, for temporary purposes, easily thrown in and thrown out, the problem is solved. The internal combustion engine transportation medium then becomes practically nothing more or less than the internal combustion engine as a prime mover, a chain for transferring the power from the crank shaft to the driving axle, and the two sprockets, one for delivrieng the power to the chain and the other for receiving same on the axle, and this is the working machine 90 to 95 per cent of the hours worked. Logically, in the face of the economy necessary in transportation business of the present day, the use of the internal combustion engine in transportation service is a necessity.

Consider a steam switch locomotive. A large part of the time it is merely consuming fuel, water, etc., at a rather high rate—waiting for work to be done; the fire must be kept up engine-propelled locomotive in which the consumption of fuel stops immediately when the engine is not being operlong before the working hours in the morning until long after working hours are over in the evening—in fact it is economical to keep the fire going twenty-four hours each day. Now compare with it the internal-combustionated. The steam switch engine ordinarily is used in shifting cars and for the most part the reverse lever is in the corner —full stroke—no use whatever being made of the expansive possibilities of steam. The steam is generated in a boiler at a certain pressure, a certain number of cubic inches of high pressure steam is transmitted through same to the cylinders, and the cubic contents of the cylinders are simply a measure of the number of cubic inches taken from the boiler. This is an excessively wasteful method of generating power, and yet this is the condition under which the switch engine normally works.

With a reasonably flexible transmission from an internal combustion engine, the engine can be worked at an economically advantageous speed under almost all conditions; so that the necessary appliances—in order to obtain the flexibility to transmit and apply the power from an internal combustion engine to the driving wheels of a transportation medium—are economical and advantageous devices after all; they are a necessity in the application of the internal combustion engine power and yet in their action the internal combustion engine is enabled to operate at all times on an economical basis.

Friction Clutch.

With friction shoes on the periphery of a wheel to retard a moving train, and friction shoes on the periphery of a wheel to accelerate a train, it is self-evident from the enormous utilization of the retarding principle that the accelerating principle is eminently safe, practical and beyond any question of success.

The air-brake of to-day is not a simple device; the brake power of the high speed brake of an ordinary passenger car comprises some rather intricate problems in the distributions and transmissions of this air pressure power. The complicated system of levers, fulcrums, air cylinders, etc., with necessary adjustments incident to wear, were not all developed in a day, and yet on account of the uniform and extensive use of the same you can employ men at wages very little above that of ordinary labor who will take care of this apparatus with very satisfactory results. With reasonable experience with the friction clutch or accelerating principle the problem is solved at once.

The use of friction clutches in mining and hoisting engines, and throwing in large bending rolls, all sorts of special labor saving devices, is old and the results obtained from the same have been extremely satisfactory and reliable; and the enormous use of the friction clutch on automobiles has disseminated such a quantity of information, such a large

number of the world's people have become acquainted with the principles involved, that the use of the friction clutch on a transportation medium is really of no great importance in the solution of the subject matter at hand.

Watt, in developing the steam engine, found that the greatest difficulty to overcome in the development of this form of power generator was the details of construction, the proportioning of parts, kind of materials, etc. Thus it is to-day; and with a reasonable consideration and study in the design and proportioning of parts, the transmitting of internal combustion power to the driving wheels, we have a practical switch engine ready for service. The prime mover is well developed, the character of the transmission of various types is well developed; the subject then resolves itself into simply a question of making patterns and necessary appropriations for manufacturing expense.

Oil Transmission.

By being submerged in oil or running in a bath of oil, in other words, being perfectly and continually lubricated many mechanical devices are rendered practicable and meritoriovs, which have heretofore been considered impracticable and unreliable. This comparatively new principle in detail machine design of mechanical devices is being rapidly introduced in modern practice and is giving remarkably uniform results.

Hydraulic presses and hydraulic operating machinery are wonderfully positive when in good order, the only criticism of them being with regard to the action of the water on the materials, leakage and a tendency to get out of order; but with the hydraulic practice of using oil as a fluid medium, such troubles are circumvented. There are already developed several oil transmissions for the transfer of power. These oil transmissions have a wonderful range of flexibility, susceptible of positive and easy control; the possibilities of them in the utilization of mechanical devices open up an enormous field of adaptability. The gasoline engine as a prime mover, therefore, with an oil transmission between it and the driving wheels of a switch engine, would give a locomotive under the control of the operator, of far more scope in its operation than a steam locomotive ever could be. These oil transmissions are used largely in operating the guns and other appliances of modern war vessels; they are the medium of control, therefore, upon which a nation may stake its very existence. It should not be then very difficult to connect driving wheels by this form of transmission to a prime mover, the internal combustion engine.

A small 200 or 300 horsepower engine with this form of transmission could be designed to give more tractive effort than a 700 or 800 horsepower steam locomotive for starting purposes. The speed of a switch engine, controlled by this hydraulic oil transmission, would vary from zero to twenty and twenty-five miles an hour, giving an infinite number of speeds. The torque from a given power could be multiplied or divided in the precise proportions necessary to the economy and prompt movement of the load handled. A 200 horsepower gasoline engine would start a 30 to 40-car train as positively as a 500-horsepower locomotive, the only difference would be in the acceleration. It is reasonable to suppose that the 500-horsepower steam locomotive would accelerate the load faster than a 200-horsepower internal combustion engine locomotive. On the other hand, the economies of transmission, the efficiency, the application of the power, the facility of manipulation with the internal combustion engine being so far superior to that of a steam locomotive, there is no question that a rated horsepower internal combustion engine would more than compete with the steam engine of very much higher rated horsepower in every-day service. Take a locomotive with cylinders 20 x 24, drivers 51 inches in diameter, boiler pressure 180 pounds, at three miles an hour; the horsepower developed by this steam engine is only 249, notwithstanding the fact that the engine is capable of developing 600 or 700 horsepower.

Fuel.

Separating wood alcohol from denatured alcohol, denatured alcohol of the present government requirements should be made at a small cost, and as a fuel readily and easily interchanged in use with gasoline in the ordinary apparatus. The application of heat to carbureting devices will easily enable the utilization of coal oil or even crude oil for switch engine purposes. The utilization of different kinds of coal, even lignites, by means of gas producers for fuel, furnishes an endless source of economy and development for the future of the internal combustion engine in its general use.

With reasonable study and development work there are a great many economies possible in the use of gasoline. It is simply a question of time when these will be obtained. Thus it is that the internal-combustion-propelled-transportation medium's field for further economies and greater adaptability is enormous and not particularly difficult, whereas any great economies in the use of the steam locomotive are practically restricted to a very narrow margin, and as a fact possible economies in steam power available to-day seem to be of such minor importance as not to justify their use by the railroads at large.

Fuel for the internal combustion engine properly mixed with air and economically utilized in the cylinders will give off practically no smoke, no disagreeable odors. The exhaust naturally will be short of oxygen, but the volume of this exhaust is minute in comparison with that of the smoke emitted from the stack of a locomotive. Thus the internal combustion engine to-day affords us a more efficient, more adaptable and more practical form of transportation medium, than the steam engine, whether it be for slow, fast or heavy freight service; there is practically no smoke, practically no noise, and it has none of the dangers, nor any of the complicated restrictions incident to a third rail electric system. Its practical introduction is simply the combining of the already mentioned parts in a composite design and the adapting of them to the certain specified duty required, and no money need be wasted in experimental investigation.

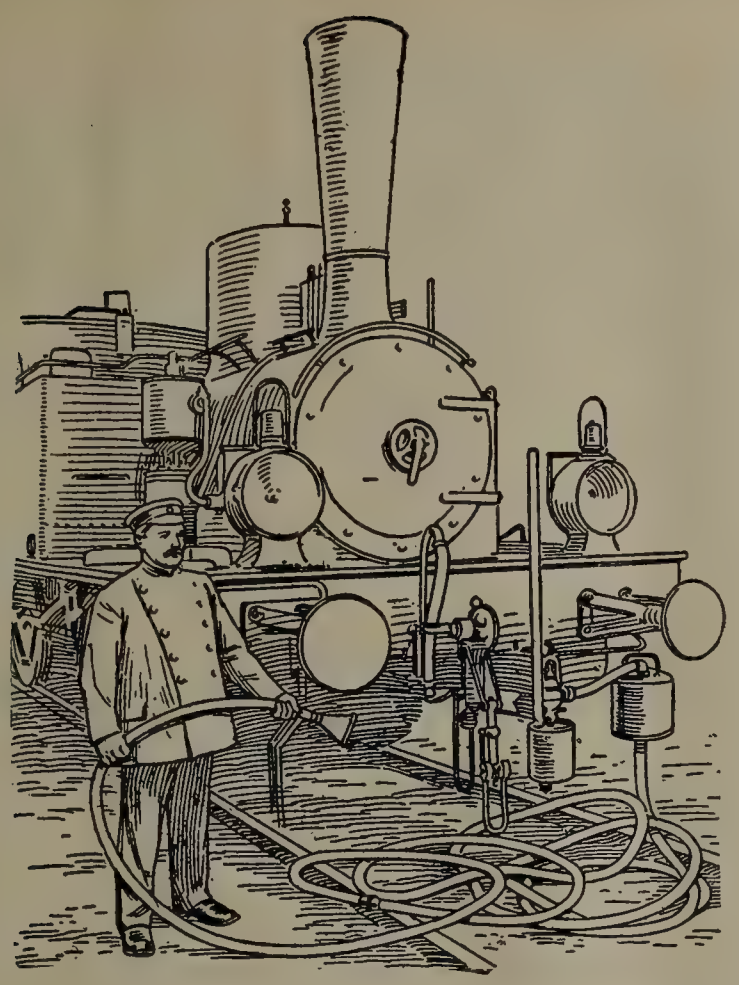
It is natural for a railroad man to have a soft spot in his heart for the steam locomotive and its accomplishments, and his judgment is more or less biased by his sympathy therefrom; the same is true of a traction man as regards electricity, the development in transportation of city and interurban business by electric methods now is and has been a great boon to civilization.

My sympathy and my love for the old steam locomotive were once just as strong and the same as those I formerly had for a Kentucky-bred trotting horse; and my confidence to-day in the internal combustion engine is simply from the intellectual pounding of the many meritorious, self-evident facts and logical principles, which I have received in this study of this engine.

LOCOMOTIVE VACUUM-CLEANER ATTACHMENT.

An apparatus by means of which a locomotive is converted into a vacuum-cleaning plant is shown in the accompanying illustration. It comprises simply a suction chamber attached to the injector valve of the locomotive, a steam trap for the condensation of water, a dust collector, which is kept partially filled with water, and the necessary amount of hose and types of suction tips or nozzles. The steam trap and dust collector are connected by means of a hose of large diameter, and the suction hose is attached to the bottom of the dust collector.

When the injector valve is opened the live steam passes the opening of the suction chamber and creates a vacuum therein, which produces the suction, drawing the dust and



Old Locomotive Equipped for Vacuum Cleaning.

dirt into the dust collector where it is retained by the water. The air, after unloading its burden of dirt, then passes into the steam trap and is exhausted into the atmosphere. With a sufficient length of hose, several passenger coaches can be vacuum cleaned by simply backing the locomotive up to one end. The apparatus is used on one of the German railways.—*Popular Mechanics.*

GENTLE HINT FOR SHORTER CUT-OFF.

A complaint was made by one of our engineers to his fireman, that if he had any pride he would take a little emery cloth and rub the rust off the throttle lever and the reverse lever. It would help the looks of things in the cab very much. "Yes," said the fireman, "if you would keep the reverse lever inside of the cab and not have it leaning out the front window in the dew all night, possibly it would not be so rusty."—Exchange.

The Pere Marquette has awarded the contract for a 16-stall roundhouse of the square or through type to be built at Ludington, Mich., to the Hauser-Owen-Ames Co., of Grand Rapids, Mich. The cost will be approximately $50,000. This company has also awarded the contract for the construction of a 12-stall roundhouse at Port Huron, Mich., to Rabbit & Son, Toledo, O.

The St. Louis Southwestern and the Texas Midland are said to be planning the erection of a new union passenger station at Greenville, Tex.

AMERICAN RAILWAY TOOL FOREMEN'S ASSN.

The American Railway Tool Foremen's Association held its third annual convention at the Hotel Sherman, Chicago, July 9 to 12. The members present numbered about forty-five. E. J. McKernan, supervisor of tools, A., T. & S. F. Ry., president of the association, presided at the meeting. Robert Quayle, superintendent of motive power and machinery at the Chicago & Northwestern, delivered the opening address.

A. R. Davis, tool foreman of the Central of Georgia, at Macon, Ga., presented a paper on the subject of "Milling Cutters and Reamers, Their Formation and Tempering." Mr. Davis said that he believed the tool foremen had been bound too much by tradition and were making milling cutters with many flutes of a given form and spiral simply because they have always been made that way. His experience indicated that considerable improvement could be made by decreasing the number of flutes and increasing the total angle of milling cutters. With 3½ in. cutters having nine flutes, and 4½ in. cutters with ten flutes, which correspond to about 1½ in. spacing, and with a $\frac{1}{32}$ in. face of tooth, he had been able to remove as high as three cubic feet of machinery steel with one grinding. Not a single cutter of this type had broken in service. Tables were included giving the number of teeth for various diameters of cutters and end mills. These were based on a spacing of 1¼ to 1½ in., which was recommended for the best results.

Henry Otto, a tool foreman of the Atchison, Topeka & Santa Fe Railway, presented a committee report on the subject of "Standardization of Steel for Small Tools." The report recommends the dividing of carbon steel into four grades, each to include a range of ten points in carbon. This would cover all steels from 65 to 105 points carbon. For forging, temperatures are suggested which range from 1,750 degrees for the first grade to 1,600 degrees for the fourth grade. For hardening the committee suggests 1,480 degrees for the first grade, and five degrees less for each successive grade. 1,250 degrees to 1,300 degrees is recommended for annealing all grades.

A paper on "Treating of Steel in Electric Furnaces," was read by B. Henrikson, tool foreman, Chicago & North Western at Chicago. He briefly explained the method of tempering special steels in a forge or furnace requiring a blast. This consists of packing the steel in powdered carbon and sealing in a metal box. There are two types of electric furnaces, one using a liquid bath and the other an open chamber, so arranged that the amount of air admitted could be accurately controlled. Barium chloride or other salts are used in the first type, a composition being selected which will become liquid at the desired temperature.

Then followed a long discussion on the subject of "Standardization of Small Tools," which covered the practice of practically all of the railways represented, in making various tools. Beading tools with 13/16 in. shanks, octagon, and forged in dies either under a hammer or in a forging machine were recommended by several of the speakers. The steel should not be hard enough to break in service. Roller expanders, staybolt drills and boiler stud taps were each discussed at length. An attempt to have the association formally recommend a taper tap with 12 threads per inch for boiler studs was defeated. The subject will be brought up again next year.

A committee on "Checking Systems for Tools," made a report which recommended giving a man, when first employed, six numbered checks. The number on the checks should correspond with his shop number. No tools should be issued except in exchange for a check and all tools should be returned to the tool room each night. No workman should receive his time until he has a clearance from the tool room foreman. An experienced man should issue all tools from the tool room.

The report of the secretary-treasurer showed the total membership to be 68 and a balance in the treasury of $60.22.

The following officers were elected for next year: President, J. Martin (C. C. C. & St. L., Beech Grove, Ind.); first vice-president, A. N. Roberts (B. & L. E., Greenville, Pa.); second vice-president, H. Otto (Santa Fe, Topeka, Kan.); third vice-president, M. B. Roderick (Erie, Hornell, N. Y.); secretary-treasurer, A. B. Davis (Central of Georgia, Macon, Ga.); executive committee, O. H. Dallman (Pennsylvania, Chicago, Ill.); C. A. Sheffer (I. C., Chicago, Ill.); A. Sterner (C., R. I. & P., Chicago, Ill.); J. J. Shee-

han (N. & W., Roanoke, Va.), and E. R. Purchase (B. & A., Springfield, Mass).

It was decided to hold the next annual convention at Chicago and the secretary was authorized to enter negotiations with the International Railway General Foremen's Association seeking to bring the convention of the two bodies in consecutive weeks for the greater convenience of thet supply men, most of whom desire to exhibit their products at both conventions.

VALVES FOR SUPERHEATER LOCOMOTIVES.

The importance of the use of superheated steam in locomotive service whereby the capacity of the locomotive is increased is so well established as to insure the very general use of superheated steam. The importance, therefore, of every adjunct connected with the use of steam at a high degree of heat is of the next importance to the superheating of the steam itself. Of these adjuncts the main valves are, no doubt, of the greater importance. It is, therefore, interesting to know that the American Balance Valve Co., which has made main valves its specialty since 1890, has developed valves both of slide and piston type which are efficient under the highest degree of heat yet obtained by locomotive superheaters.

The latest development of the semi-plug piston valve provides a predetermined limit of wear to the rings, after which the rings are automatically converted into absolute plugs. The principle of the semi-plug valve is to allow the rings to expand by their own tension and to be set out by jets of steam until the rings fit the valve cage, then by the steam pressure operating the locking rings the packing rings are held from bearing against the cage, making an automatically adjusted plug—the ideal valve—which cannot wear the cage.

This has worked so well in saturated steam that rings have been allowed to run without attention until mileages as high as 140,000 in freight and 120,000 in passenger have been made without changing packing. Under such remarkable service it is very natural that the valves would receive very little attention and in this there was danger of letting them remain in service until they were so completely worn out as to be in danger of breakage; and in superheat this is magnified because of greater difficulty in lubrication. It has been found advisable, therefore, to limit the wear of rings to a predetermined amount, after which the rings become absolute plugs, and further expansion being impossible, warning will be given that rings require changing and new wearing rings are taken from stock and applied without machine or hand work on rings or spools. Therefore, the improvement in this valve was designed to remedy these points by doing away with the necessity of frequent inspection to determine when packing is worn out, by automatically giving notice and louder and louder insisting on attention, while at the same time automatically preventing the wearing of rings to the danger point, by completely stopping the expansion of the rings at the predetermined point allowed for wear. This automatic watching and control of the packing is accomplished in a very simple manner and is of greater importance than might at first appear.

The ideal valve would be a plug ground perfectly to a sliding fit in its chamber, but the law of expansion and contraction renders it impossible to reach such an ideal condition with a solid plug; but in addition there is the impossibility of carrying the plug in so closely fitting a cage so as to keep it from contact with bottom of cage in a horizontal engine. It would seem, therefore, that the ideal conditions have been reached in the semi-plug piston valve which automatically cares for expansion and contraction and still gives the frictionless service of a plug and in further supplying to the valve a self-protection against "overdoing a good thing." Considering the feature of confining all wear to the rings which are duplicated from stock, the designers of this valve have improved on the plug and produced a valve that gives satisfactory results under the exacting requirement of the main valves in superheated steam locomotives.

It is very interesting to know that a slide valve can be operated under 650 degrees temperature of steam, the Jack Wilson valve having been operating since December, 1909, under these conditions and is being applied in other cases which will further demonstrate its ability to meet the conditions of superheat. Since there are a great many slide valve engines still in use that could be equipped with superheat if the satisfactory valves were obtainable and thereby avoid the expense of changing the cylinders simply for the purpose of using superheat, this slide valve becomes more interesting.

JOURNAL BOX WEDGES.

Editor Railway Master Mechanic:

I am submitting herewith a table illustrating the effect of different widths of wedges in different sizes of boxes.

The first column gives the capacity of car in tons; the second column, the weight of load less wheels and axles; the third column, the weight on each journal; the fourth column the size of the journal; the fifth column, the dimensions of the brass actually in contact; the sixth column, the projected area; the seventh column, the load in square inches on the brass, and the eighth column, the width of the wedge.

The wedge, due to its crowned surface, has theoretically a line contact between the ceiling of the box and the wedge,

CAP. CAR TONS	WEIGHT OF CAR LESS WHEELS & AXLES	WEIGHT ON JOURNAL CAR LOADED	SIZE JOURNAL	DIMENSIONS OF BRASS IN CONTACT	PROJECTED AREA BRASS SQ. IN	LOAD PER SQ. IN. ON BRASS	WIDTH OF WEDGE	LOAD PER LINEAL INCH ON WEDGE	20-TON	30-TON	40-TON	50-TON	70-TON		
													B. & O. PENN.	HARRIMAN	McCORD STD.
20	17600	7200	3¾"×7"	3¼" × 6¼"	20	360	4.5"	1600	4.5"	3.41"	2.94"	2.57"	2.28"	2.14"	2.72"
30	22400	10300	4¼"×8"	3½" × 6⅞"	24	429	4.875"	2115	6.45"	4.875"	4.2"	3.68"	3.26"	3.03"	3.89"
40	30400	13800	5"×9"	4" × 7⅞"	31½"	438	5.625"	2450	8.63"	6.54"	5.625"	4.94"	4.37"	4.06"	5.21"
50	36800	17100	5½"×10"	4½" × 8⅞"	40	427	6.125"	2800	10.7"	8.1"	6.98"	6.125"	5.41"	5.03"	6.46"
70	40000	22500	B&O.-PENN. 6"×11"	5" × 9⅞"	49½	455	7.125"	3157	14.06"	10.63	9.2"	8.03"	7.125"	6.625"	8.500"
70	40000	22500	HARRIMAN 6"×11"	5" × 9⅞"	49½	455	6.625"	3398	14.06"	10.63"	9.2"	8.03"	7.125"	6.625"	8.500"
70	40000	22500	McCORD STD. 6"×11"	5" × 9⅞"	49½	455	8.500"	2647	14.06"	10.63"	9.2"	8.03"	7.125"	6.625"	8.500"

Comparison of Widths of Wedges Proportionate to Weight on Brass.

NOTE - UNDERLINED FIGURES SHOW PRESENT M.C.B. WIDTH OF WEDGE, AND WIDTH OF WEDGES SHOWN IN SAME COLUMN INDICATE WHAT THE WIDTH WOULD BE IF SAME PROPORTIONATE BEARING WERE GIVEN TO THE OTHER SIZES.

which makes necessary a comparison of the load per lineal inch between the ceiling of the box and the wedge.

Column 9 gives the load per lineal inch on the wedge.

You will note there is 1,600 lbs. per lineal inch on the 20-ton wedge, which is 4.5 in. wide, and 2,115 lbs. on the 30-ton wedge, which is 4.875 in. wide. If the width of the 30-ton wedge were correct for that load, the 20-ton wedge should be 3.41 in. wide instead of 4.5 in., or if the width of the 20-ton wedge is correct, the width of the 30-ton wedge should be 6.45 in. Note again 2,450 lbs. per lineal inch on the 40-ton wedge, which is 5.625 in. wide. Assuming this to be correct, the 30-ton wedge instead of being 4.875 in. wide would have to be 4.2 in. wide, and the 20-ton would have to be 2.94 in. wide instead of 4.5 in., or if the 20-ton wedge were correct, the 40-ton wedge would have to be 8.63 in. wide, and if the 30-ton wedge were correct, the 40-ton wedge would have to be 6.54 in. wide.

We have underlined in each case the widths of the wedges used, the 20, 30, 40 and 50 tons being M. C. B. standard, the three different widths of wedges of the 70-ton being various designs now being used.

The point I wish to bring out is that we have increased the load from 1,600 lbs. to 3,398 lbs. per lineal inch on wedges. We have found considerable trouble with the 50-ton wedges, with a load of 2,800 lbs. per lineal inch, seating in the top of boxes. In fact, one railroad has gone to the extreme of attempting to put a steel insert at this point in gray iron boxes to increase the length of time the wedges in 5½x10 in. boxes are adjustable. We have never heard of any wedge seating trouble in the 40-ton boxes, from which we assume that some place between the loading per lineal inch of the 40 and 50 ton boxes should be determined upon and that loading per lineal inch used on journal boxes of future design.

You will note if we were to assume that the 40-ton wedge is correctly loaded, the wedge in 6x11 in. boxes would have to be 9.2 in. wide instead of 6.625 in., and 7.125 in. as two present designs. We have assumed a load of 2,647 lbs. per lineal inch in designing wedge 8.5 in. wide.

(Signed) W. J. Schlacks.

Personals

T. H. Goodnow, general superintendent of the Armour Car Lines, has been appointed assistant superintendent of the car department of the Chicago & North-Western at Chicago, succeeding C. H. Osborn. A photograph and biographical sketch of Mr. Goodnow was published in the February issue of the *Railway Master Mechanic*. Mr. Osborn becomes vice-president of the Mid-Western Car Supply Co., with office at Chicago.

J. R. Sexton has been appointed mechanical superintendent of the western lines of the Atchison, Topeka & Santa Fe, with office at La Junta, Colo.

Frank Zeleny has been appointed engineer of tests of the Chicago, Burlington & Quincy, succeeding the late W. A. Derby. His office is at Aurora, Ill.

C. E. Croom succeeds J. T. Freeman as general foreman of the Atlanta, Birmingham & Atlantic, with office at Manchester, Ala.

E. W. Grice has been appointed assistant to the fourth vice-president of the Chesapeake & Ohio, the Chesapeake & Ohio of Indiana and the Hocking Valley, his former office of general manager being abolished.

John C. Maclay has been appointed a superintendent of the Erie, with office at Buffalo, N. Y.

J. P. Kirkpatrick has been appointed superintendent of the Grand Trunk Pacific, vice W. B. Cronk, resigned. His office is at Regina, Sask.

P. W. Robertson has been appointed superintendent of transportation of the Gulf Line Ry., with headquarters at Sylvester, Ga.

D. W. Newell has been appointed superintendent of the Tallulah Falls, vice Edwin Luckett, deceased. His office is at Raleigh, N. C.

J. P. McMurray has been appointed master mechanic of the Atchison, Topeka & Santa Fe, with office at Albuquerque, N. M. He succeeds L. A. Mattimore.

T. F. Sullivan has resigned as master mechanic of the San Antonio & Aransas Pass at Yoakum, Tex.

C. C. Elmes succeeds F. Galvin as master mechanic of the Texas & New Orleans, with office at Houston, Tex.

L. A. Stoll, general foreman of the Chicago, Burlington & Quincy at Aurora, Ill., has been appointed assistant superintendent of the Aurora shops in charge of the locomotive department. Wm. Queenan has been appointed assistant superintendent in charge of the car department.

L. R. Johnson has been appointed general superintendent of the Angus shops of the Canadian Pacific, with office at Montreal, Que. H. Osborne succeeds Mr. Johnson as assistant superintendent of motive power at Montreal.

R. J. Turnbull has been appointed mechanical superintendent of the Missouri Pacific system, with office at St. Louis. Mr. Turnbull was formerly acting superintendent of machinery of this system.

B. A. Aikens has been appointed purchasing agent of the Michigan Central succeeding J. F. Farrell, who has been elected vice-president of the St. Louis Southwestern. Mr. Aikens' office is at Detroit, Mich. He also succeeds Mr. Farrell as general tie agent of the other New York Lines West.

E. F. Stroeh, master mechanic of the Missouri Pacific at Hoisington, has been transferred to Kansas City, succeeding W. C. Smith, who has been made general master mechanic, with office at Little Rock. W. G. Siebert succeeds Mr. Stroch at Hoisington, Kan. J. D. Young, formerly general foreman, has been appointed master mechanic at Falls City, Neb., to succeed Mr. Siebert.

J. F. McDonough succeeds J. R. Sexton as master mechanic of the Santa Fe at Ft. Madison, Ia. I. Wellman succeeds Mr. McDonough as master mechanic at Newton, Kan.

F. E. Foster has been appointed assistant superintendent of the Sonora division of the Southern Pacific R. R. of Mexico, with office at Empalme, Son., Mexico.

New Books

DIARY OF A ROUND HOUSE FOREMAN. By T. S. Reilly; 176 pages, cloth, 4¾x6¾; published by the Norman W. Henley Publishing Co., 132 Nassau St., New York. Price $1.00.

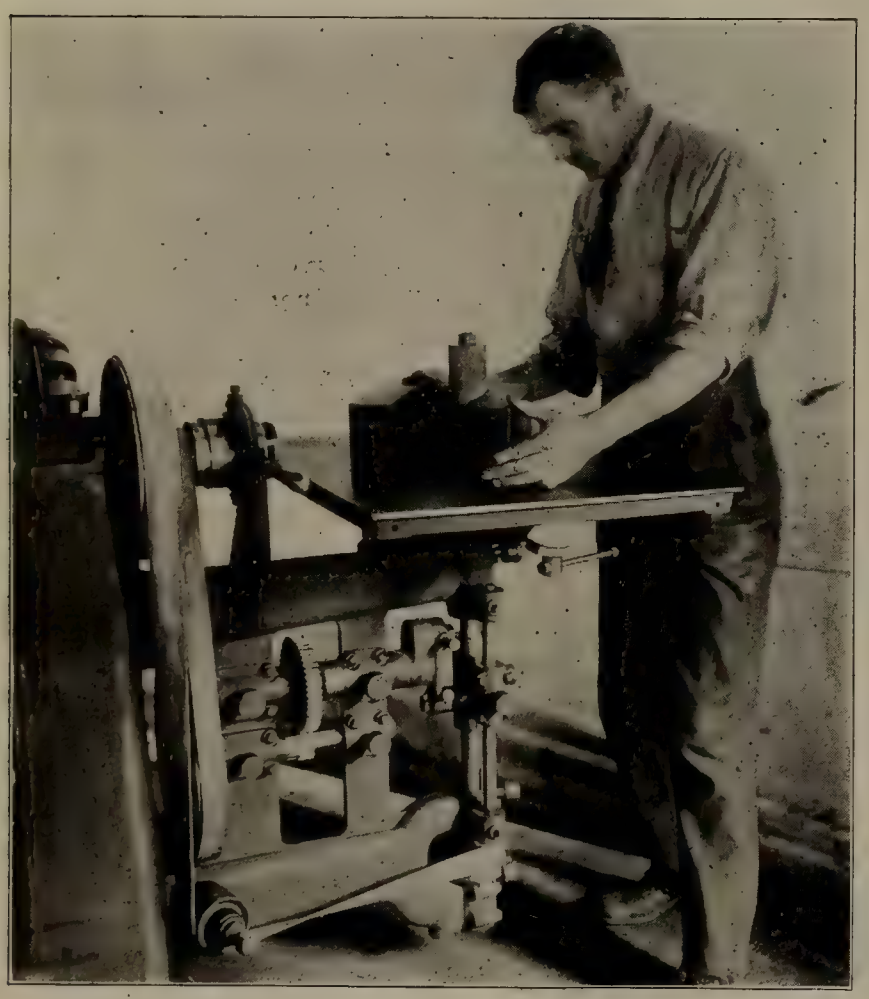
This is a book of the personal experiences of the author as a railway mechanical employee and officer. The story first appeared serially in the *Railway and Engineering Review*, of which paper Mr. Reilly was for two periods associate editor. The author has kept in view the definite object of supplying needed information on the administrative duties of the round house foreman, and to this end he places a typical young machinist of good education in charge of a round house, and sets forth a portrayal of his experiences from the first day of the assumption of the duties until his promotion in the service. Those who knew the author recognize in the story the subtle Irish humor which marked his conversation as well as his writing. Railway officials in any department will thoroughly appreciate and enjoy the hints and experiences of this story.

Among The Manufacturers

COMBINATION DISC GRINDER AND DRUM SANDER FOR WOOD PATTERNMAKING.

In the illustrations herewith is shown a new pattern makers' disc grinder manufactured by Charles H. Besly & Co., Chicago. The gear guards are removed to show the construction.

The disc wheel is steel, 30-in. diameter, ¾-in. thick, and runs 750 R. P. M. The work table serving the disc wheel is 14 in. wide by 40 in. long. It may be tilted and locked at any angle from 75 degrees to 135 degrees from the plane of the grinding disc, large graduations being provided to govern this angular adjustment. The construction is such that the inside of the working edge of the work table remains within 1/32-in. of the grinding disc, regardless of angular adjustment, and the supporting mechanism is back of the disc wheel and below the face of the work table so that the top of table is always clear of obstructions.

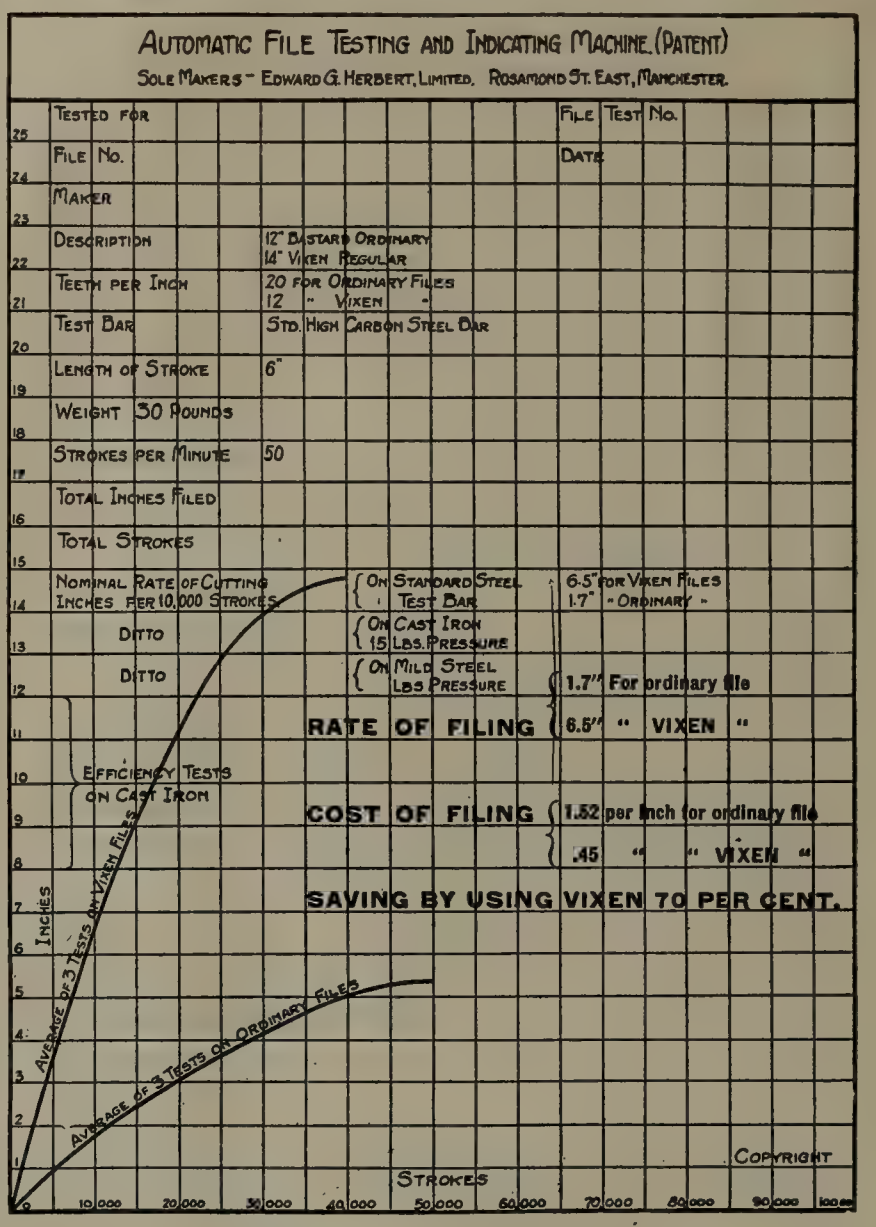


Sand Drum Attachment Finishing Curved Surface.

The work table has a vertical adjustment of 25 in., and being supported by a round vertical shaft, it may be swung away from the grinding disc for convenience in resetting the wheel or facing off extra large patterns.

The machine is equipped with four work table attachments, as follows: a sizing circle gauge for cylindrical and conical grinding; a sliding bevel gauge for simple and compound angle grinding; a sizing bevel gauge for simple and compound angle grinding to dimensions; an angle plate for free-hand cornering of thin work.

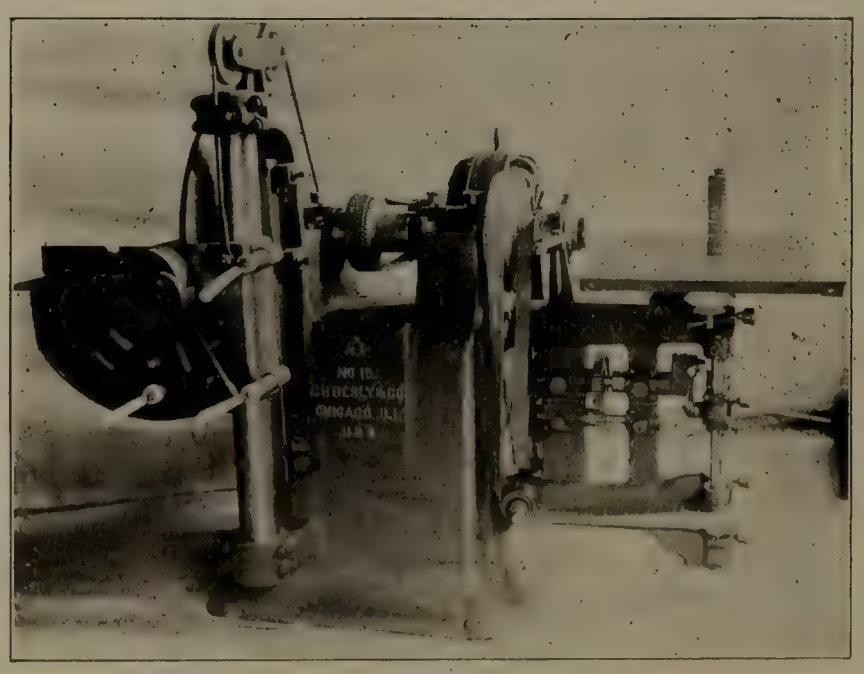
The machine carries a telescoping dust hood, which may be piped to exhauster for withdrawing the grinding dust. The drum sanding attachment has a work table 24 in. x 28 in. It may be tilted and locked at any angle from 85 degrees to 105 degrees from axis of sand drum. The sand drum shown is 2½ in. diameter by 8 in. long, but drums from 1 in. to 6 in. diameter of any reasonable length may be used. The work table has a central round opening 8½ in. diameter, into



Results on File Testing Machine.

which are fitted circular plates with center holes to accommodate various sizes of drums. The sand drum runs 2,250 R. P. M., and has a perpendicular reciprocating movement while running, to equalize the wear on the abrasive. This movement is actuated by crank and link as shown and is adjustable from 0 to 4 in. The machine is driven by 3-horsepower motor mounted on bracket bolted to rear of machine bed. Drive is through sprockets and Link Belt silent chain.

The machine occupies a floor space of 54 in. x 84 in. and weighs 2,800 pounds. It is made with 30-in. or 40-in. diameter disc wheels, belted or motor driven.



Combination Disc Grinder and Drum Sander.

FILE TESTS.

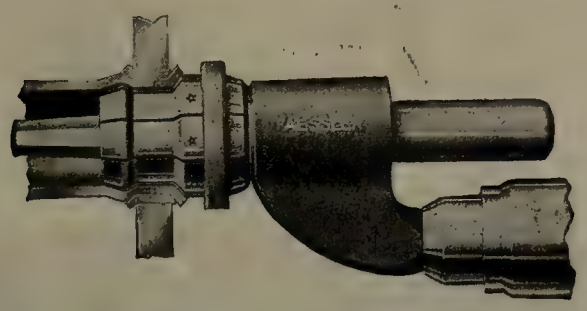
One of the interesting exhibits at the Atlantic City conventions in June was that of the Vixen Tool Co., of Philadelphia, makers of the Vixen file. Here was conducted the first public file test made in this country. This was made on the Herbert file testing machine, which is automatic in action and does away with the personal element which is bound to enter otherwise, as it is impossible to always have the same conditions when testing by hand. The tests were made on "Vixen" files and a number of other files purchased in the open market at Atlantic City. They were made under exactly similar conditions and the results plotted on cross-section paper as shown in the figure. The tests shown in the figure were conducted previously, but the results obtained at Atlantic City were just as satisfactory and showed very clearly the superiority of the Vixen file.

Each test at Atlantic City covered a period of from thirteen to twenty-four hours and the machine was run at a speed of 3,000 strokes per hour. In 50,500 strokes covering a period of 16 hours and 50 minutes, a Vixen file cut 21.6 cubic inches of metal. Another file of standard make, in 41,000 strokes, covering a period of 13 hours and 40 minutes, cut 8.7 cubic inches. In figuring the cost of this work, as done by workmen at 50 cents per hour, the cost per cubic inch of metal removed is 39 cents for the Vixen and 79 cents for the other file, showing a saving in labor cost of 51 per cent. These figures are for first life only. It is stated that the Vixen file can be resharpened four or five times, whereas the economy of recutting commercial files is often questioned.

QUICK-ACTING SECTIONAL BOILER TUBE EXPANDER.

The essential new feature of the Faessler safety sectional expander with quick-acting-knockout is the mandrel extractor—a sleeve fitting loosely over the mandrel and having an extended arm to receive blows, so that part of the force of each goes to the expander sections to free them from the mandrel, and part goes to the side of the mandrel, to loosen it sidewise without marring.

Faessler Expander with Hammer Placed to Expand the Tube.



Faessler Expander with Hammer Applied to Mandrel Extractor.

This is a decided improvement over the ordinary method of banging out sectional expander mandrels by side blows from a hand hammer, which is bad for the tube, the mandrel and the expander sections, and is a source of danger and of expense and delays for renewal of broken expander parts.

Tube expansion with this new Faessler tool is accomplished in the usual way and with the standard long taper mandrel. The extractor does not in any way interfere with expansion and to save time may remain upon the mandrel. To loosen or extract the mandrel after expansion is completed requires no flogging hammer where a pneumatic hammer is used. The operator merely shifts the point of application of the air hammer from the back end of the mandrel to the end of the lug on the extractor collar. The mandrel then releases itself almost instantaneously and backs out quicker than it entered.

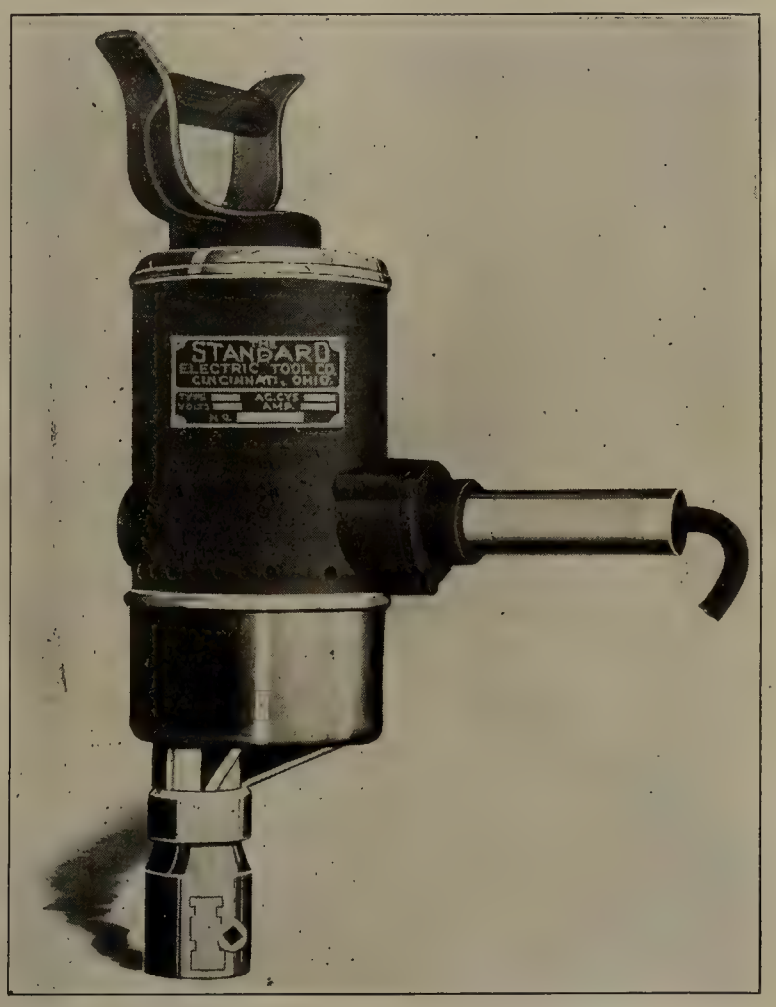
Theoretically each hammer impact forces the collar against the adjacent expander segment and moves it lengthwise before the balance of the segments are affected. The contact of collar and expander segments also affords a fulcrum over which the entire sleeve moves to impart to the mandrel a slight lateral impulse which further tends to break contact with the expander segments. Where the mandrel is driven by a hand hammer, a few taps of the latter on the extractor lug are equally effective.

It is said by the manufacturers, the J. Faessler Mfg. Co., Moberly, Mo., that this new tool operated by one man can expand more flues perfectly in a given time than can the two men required with an ordinary tool, and the danger of accident is practically eliminated.

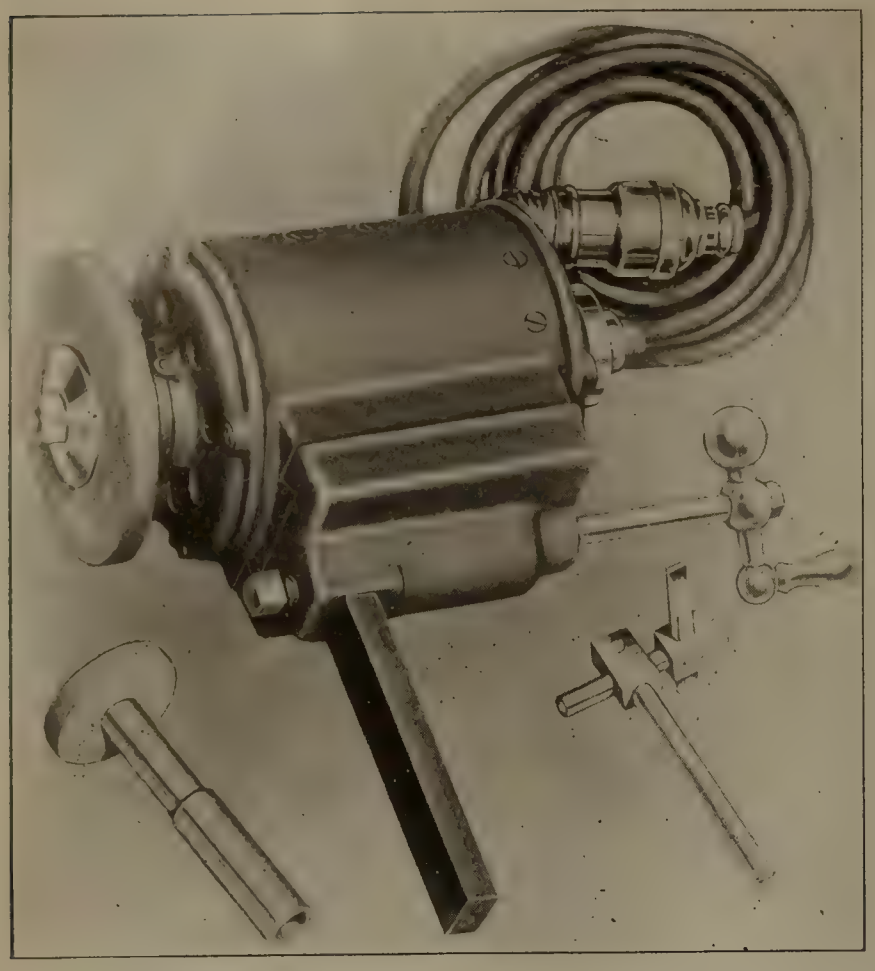
HIGH POWER ELECTRIC TOOLS.

The Standard Electric Tool Co., Cincinnati, Ohio, has developed a number of high power electric drills and grinders.

The drills are ball bearing throughout. All gears are generated from chrome nickel steel, case hardened and are mounted on ball bearings packed in grease. The highest grade German bearings are used. The motors carry a strong series winding which gives them an excess of power over rated capacity, preventing overloads. The best machine tool practice is employed in the mechanical construction, the idea of simplicity and strength being carefully followed. The drills are built in ⅜ in. and ½ in. sizes for direct and alternating current. The ½ in. D. C. drill is guaranteed to ream up to $\frac{7}{16}$ in. in thick metal. In addition a universal drill of ⅜ in. capacity that will operate on both direct and alternating current is made. These drills are built and recommended for the most rigorous and hardest constant service.



Standard Portable Electric Drill.



Standard Tool Post Electric Grinder.

The armatures and poles in both drills and grinders are built up of the best soft electrical sheet steel and are uniformly insulated.

The grinders are made for tool post, bench and parallel work. A special feature in connection with the tool post or center grinder is a base which converts it into a bench grinder, by removing a slide and placing the motor in the groove in the top of the base. This doubles the range of work and increases the value of the tool in all shops, because while tool post grinders are indispensable they are used only at intervals, and by this combination they can be kept in constant service. The motors in both drills and grinders are force ventilated by fans of special design.

OKADEE BLOW-OFF VALVE.

A blow-off valve of interesting design has been placed upon the market by the Okadee Co., of Chicago. It is simple in construction, being composed of eight parts and is a self-grinding valve, reseating itself in a different seating every time the valve is used. The body is of the best grade of gray iron, the yoke of cast steel, the stems of machine tool steel and the bushing of brass. Each valve is tested to 500 pounds cold water pressure before leaving the factory.

This valve can be used as a blower valve. In blower service it is attached to the blower pipe in the cab with a rod running across so that the engineer can operate it at the same time he shuts off the engine, thus preventing an excessive amount of smoke. Needless to say, it is much quicker in action than the ordinary globe valve, as it has a straight away blow and nothing can lodge in it. As a blow-off cock it will drain a boiler four or five minutes quicker than any other valve. There are no bolts, nuts, studs or packing to maintain and in working on the valve, it is not necessary to take it off, as the handle can be taken off and the outside seat, disc and yoke easily removed. One of these valves recently tested to destruction is said to have withstood a pressure of 2,200 pounds before being rendered unfit for service.

SENSITIVE STAND FOR DUNTLEY ELECTRIC DRILLS.

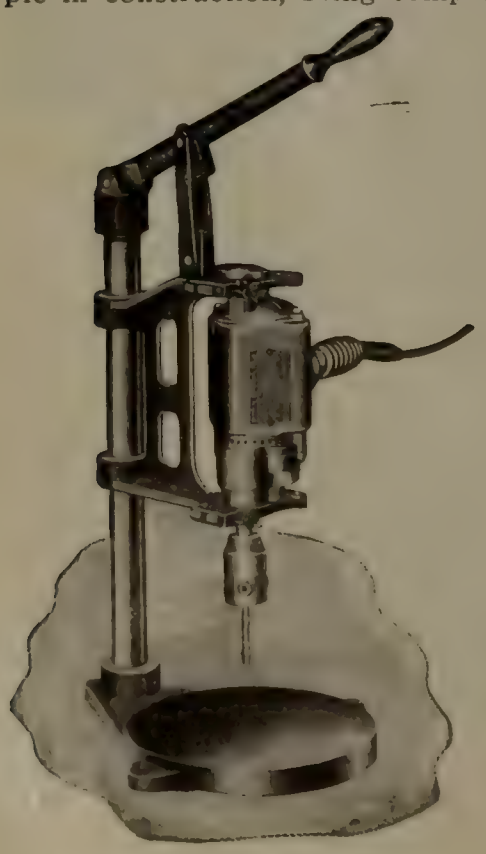
The Chicago Pneumatic Tool Co. has placed on the market a sensitive drilling stand for Duntley electric drills which promises to fill a need where accurate and rapid drilling is required. The stand is strong and substantially made throughout, and is built to take standard portable drills of either the No. 000 or No. 000x type, which are of $\frac{3}{16}$ inch and $\frac{1}{4}$ inch capacity in metal respectively. The drill itself is held in place by two clamping straps, shown in the cut, secured by screws and thumb nuts. It can be removed from the stand in a few seconds, and used as portable tool.

ALL STEEL CAR LADDER.

The illustration shows in detail the Acme all-steel ladder, which is made up of pressed steel and consists of two continuous stiles, the required number of treads, and four straps fitted over the stiles for attaching to the car. The straps are riveted to the stiles and the treads are spring-fitted into the stiles.

This ladder fulfills the specifications of the Interstate Commerce Commission and has decided advantages. It is light in weight and ample in strength. It is attached to the car by only four bolts. Repairs can be easily made by removing three bolts, which allows complete dissembling.

The stiles as shown by Fig. 2 are made of inverted "U" shapes, with the legs formed over $\frac{1}{4}$ inch along the edges. This allows complete access of air to all parts of the stile, thus preventing corrosion and the shape provides ample strength. The length of the stiles is made to suit conditions.



Sensitive Drilling Stand.

Okadee Blow-Off Valve in Position.

It is worthy of special note that the hole punched in the stile for the insertion of the tread is provided with a continuous ledge of ⅜ inch around the entire hole, thus providing a solid bearing for each tread in the stile.

The depth of the stile is 2½ inches, and its width at the top ¾ inch, and at the base 1¼ inches. It is made of steel ⅛ inch thick.

As shown by Figs. 3 and 4, the treads are formed up so that there is a space left open, which is closed when the tread is fitted into its position in the stile, thus providing a spring fit of the tread which securely holds it in position. The shape of the tread not only furnishes a very good grip for hands and feet, but also makes an unusually strong construction. The depth of the tread is 1¼ inches, and it is ¾ inch wide and made of steel ⅛ inch thick. Each tread is carefully made to exact dimensions.

As shown in Figs. 5 and 6, the straps are attached to the stiles by means of rivets and are further held in place by means of the tread, which engages the stile and strap at the same time. The strap holds the stile out from the car and thus allows free access of air all around the ladder and also permits of easy inspection. The strap is bolted through the sheathing of the car by means of a half-inch bolt, and has a total depth of 3¾ inches and a total base of 2 15/16 inches. It is three inches long and is made of steel ⅛ inch thick. The toe of the strap can be turned either outward or inward as desired.

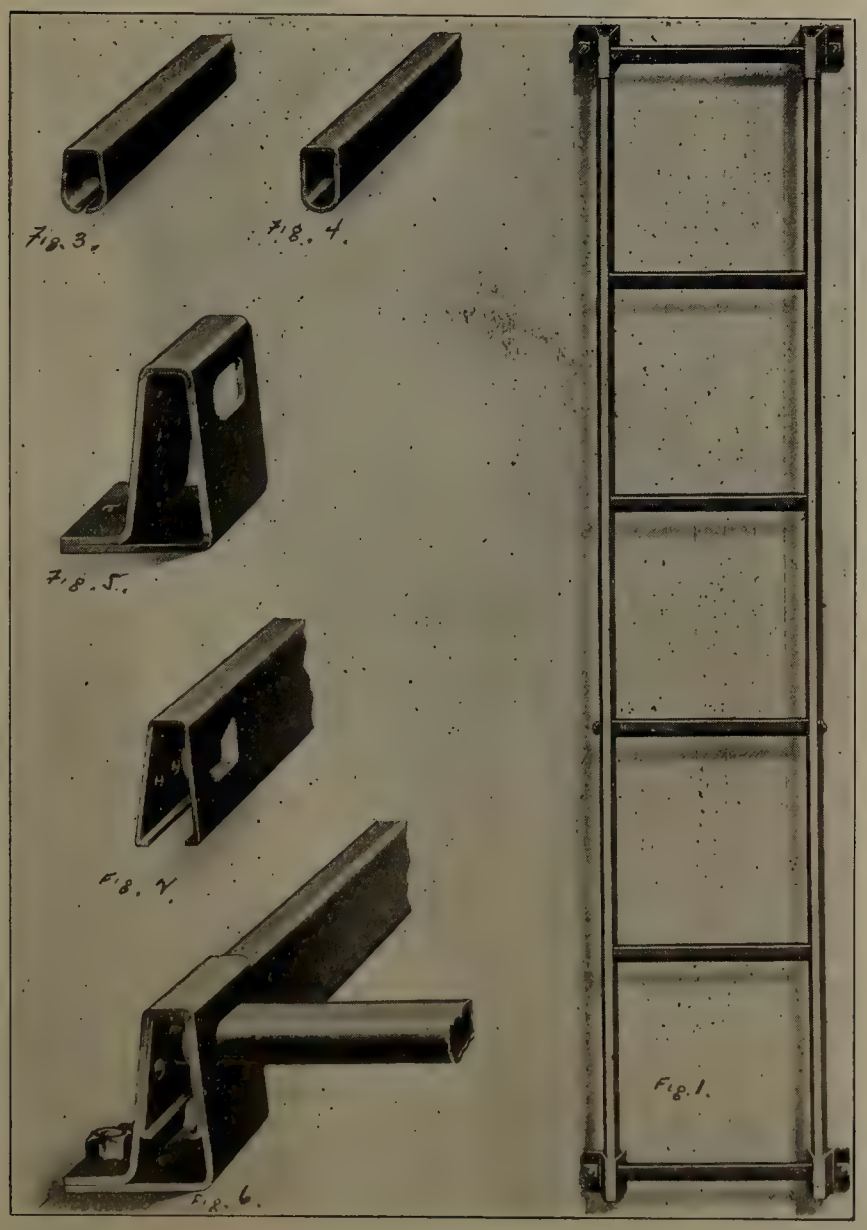
In a five-round ladder a tie-rod is placed from one stile to another through the tread at the middle. On a six-round ladder it is placed at the third tread from the bottom, as shown in Fig. 1. The purpose of this tie-rod, which is ¼ inch in diameter, is for ease in making repairs. To make repairs it is only necessary to take out the tie-rod and two strap bolts and one stile can be completely removed. This ¼-inch bolt also serves as a tie-rod when the ladder is completely assembled and applied to the car.

These ladders can be very easily assembled on the job by simply inserting the treads into the stiles and locking everything together by means of the tie-rod. The straps are all attached to the ladder at the factory and if desired the treads, straps and stiles can be assembled complete at the factory.

The parts are made standard so that repairs can very easily be made; they can be furnished upon receipt of dimensions as to length, etc. Any part can be placed in position in the ladder by simply removing the tie-bolt and two of the strap bolts, which permits the removal of one stile complete.

The approximate weight of the five-round ladder is twenty-five pounds, and of the six-pound ladder thirty pounds.

This ladder is made by the Acme Supply Co., Chicago.



Acme Steel Ladder.

New Literature

The Chicago Pneumatic Tool Co., of Chicago, has issued booklet No. 115, which, as the foreword states, is a large treatise on the bones, muscles, digestion, respiration, circulation, nerves and brain of the "Little Giant" commercial car.

A neat booklet has been issued by the Westinghouse Electric and Manufacturing Co., of Pittsburgh, descriptive of the latest types of Baldwin-Westinghouse electric locomotives. It is plentifully supplied with illustrations.

The American Infusion Steel Process Co., of New York, has issued a book of instructions covering the use of "Stelpro." It is of convenient size to slip easily into the pocket.

The advantages of the Ray self-contained snow flanger are set forth in a recent publication of the Railway Appliances Co., of Chicago. This is one of the latest and most efficient devices for this purpose.

Book No. 114 of the Chicago Pneumatic Tool Co. gives complete instructions for the operation of gasoline motor trucks in general and the "Little Giant" railroad car in particular.

The Wine Railway Appliance Co., of Toledo, Ohio, makers of locomotive and car specialties, has just issued a pamphlet on the Wine steel ladder and the Wine ventilating shutter. Each of these devices is simple in construction and low in cost for repairs and maintenance.

The Alcohol Car Heating & Lighting Co., of Chicago, in a recent publication sets forth the merits of its new system of car heating. Briefly this consists of an alcohol burner and system of ducts for the transference of the heat.

"McKeen Gasoline Motor Cars" is the subject of a book recently issued by the McKeen Motor Car Co., of Omaha. A large number of illustrations are given showing the different types of this well-known car which have been constructed. Also considerable detailed information with regard to the different types and sizes.

A book has been issued by L. B. Stillwell, Consulting Engineer, New York, on the side truss construction in steel cars. A large number of designs made by Mr. Stillwell are shown. Among these are the cars used by the Hudson & Manhattan Railroad through the New York tubes.

The Columbia Nut & Bolt Co., of Bridgeport, Conn., has recently issued a revised price list of Columbia lock nuts. Also a price list and description of their new Gib Nut.

An accuracy bulletin has been issued by the American Tool Works Co., of Cincinnati, O., for the purpose of showing by means of illustrations and short descriptions the accurate workmanship which enters into the construction of American tools. It takes up in turn, lathes, planers, shapers and radial drills. The matter is set in large type and is easily readable.

The L. S. Starrett Co., of Athol, Mass., has issued a leaflet descriptive of its Chicago store at 17 No. Jefferson street.

The Dayton Mfg. Co., of Dayton, Ohio, has published a catalog of "Dayton sanitary fixtures for railway cars." The line is very complete, and the catalog is well worthy of the attention to those interested.

The Lea Equipment Co., of Philadelphia, has issued a folder on the "Science of cutting metal cold."

The American Vanadium Co., of Pittsburgh, has issued a very attractive booklet on the subject of Vanadium steels, giving their classification and heat treatments, with directions for application of Vanadium to iron and steel. The subject matter is very interesting and instructive.

The Brown Hoisting Machinery Co., of Cleveland, Ohio, in a recent pamphlet describes the locomotive coaling station installed by this firm. The description and illustrations are very complete.

The use of superheated steam is increasing rapidly, and a pamphlet issued by the Locomotive Superheater Co., of New York, is particularly interesting at this time. This pamphlet takes up the use of superheated steam in locomotive practice, and gives much valuable information concerning the different types of superheaters manufactured by the Locomotive Superheater Co.

W. E. Marvel, Pres., M. C. B. Co., Chicago.

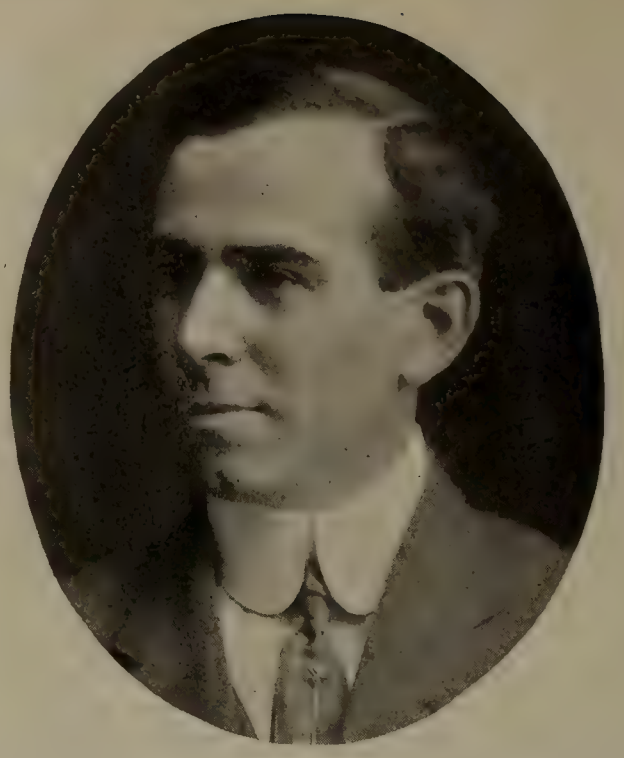
A 188-page catalog has been issued by the Lidgerwood Mfg. Co., of New York, covering the complete line of hoisting equipment made by this firm. This includes drills, cableways, log-handling machinery, hoisting and conveying apparatus, scrapers and bucket unloaders.

Catalog No. 85, illustrating three types of Hydro-Pneumatic Wheel Presses and listing and describing over seventy variations in type and size of from 60 to 600 tons capacity, has just been published by the Watson-Stillman Co., New York City. The hydro-pneumatic feature in wheel presses is exclusive with this company.

Industrial Notes

As previously noted, the M. C. B. Co. has been organized to deal in railway supplies and equipment. Its officers, from whose initials the company takes its name, are: Walter E. Marvel, president; Frank A. Buckley, vice-president, and Erle C. Cowgill, secretary-treasurer.

The company has been incorporated under the laws of Illinois for both manufacturing and dealing in railway supplies. It will act as the exclusive sales agent in the western territory for the Russell Car and Snow Plow Company, of Ridgeway, Pa., and has arranged for the representation



Erle C. Cowgill, Sec.-Treas., M. C. B. Co., Chicago.

of a number of other high class manufacturers. The equipment which is handled places the company in both the railway mechanical and railway engineering fields. Some of this equipment is as follows: Snow plows, miscellaneous cars, flangers, sweepers, ice diggers, pneumatic tools, anti-rail creepers, track and bonding tools, cattle guards, tool grinders, portable kerosene lights, reflex water gauges, hand-made wrecking and derrick chains, motor cars, ball and cone bearing jacks, etc.

F. A. Buckley, V. P., M. C. B. Co., Chicago.

The above mentioned officers are well known among both railway officials and supply men. A brief biographical sketch of the life of each since he has entered railway work, follows:

Walter E. Marvel, president of the company, entered railroad service in 1897, serving as clerk in the train master's office of the Illinois Central at Clinton, and later at Carbondale; in 1898 he was transferred to the superintendent's office at Clinton, and later to Freeport when the superintendent was moved to that point. He was promoted in 1902 to the position of private secretary to the chief engineer and the following year was given the same position under General Manager Wallace. When Mr. Wallace went to Panama as chief engineer on the canal, Mr. Marvel became connected with The Buda Company as office manager

at Chicago. He was later transferred to New York as manager of the export department, and then served five years as general southwestern manager for the same company at St. Louis. He became western sales manager of the Detroit Seamless Steel Tubes Co., at Chicago, Jan. 1, 1911, which connection he severed to become president of The M-C-B Company.

Frank A. Buckley, vice-president, entered the service of the Illinois Central R. R., in the division offices at Cairo, Ills., in 1889, and was later transferred to the executive office of that company at Chicago. In 1902 he resigned to engage in the railway supply business and has been since that time western representative of the Armspear Manufacturing Co., of New York, and the Central Railway Signal Co., of Pittsburg, with which lines he has been eminently successful.

Erle C. Cowgill, secretary and treasurer, has had twenty-two years of business experience in various lines. For three and one-half years he was secretary to the general superintendent of the Chicago & Alton, later becoming engaged in commercial business for several years. He re-entered railroad service in 1902 as private secretary to the general manager of the Illinois Central, later serving in the same capacity with the second vice-president. He was for two years chief clerk to the second vice-president of that company and from 1906 to date of his recent resignation was assistant to Presidents Harahan and Markham.

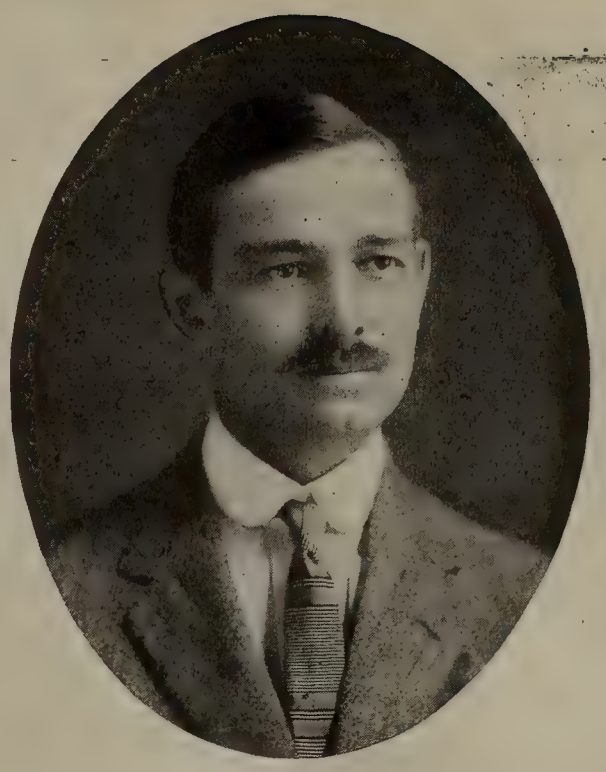
B. M. Osbun has resigned as president of the Boss Nut Company, to accept the presidency and treasurership of the Auto Refrigeration Company, with offices in the Peoples Gas Building, Chicago, Ill. J. T. Benedict, formerly vice-president, has been elected president of the Boss Nut Company, to succeed Mr. Osbun.

Friends of Wm. White, president of the National Boiler Washing Co., Chicago, are pleased to note of his return to business after eight weeks of enforced absence on account of ill health. For some months Mr. White had been troubled with

Wm. White

severe headaches, which, in connection with a general run-down condition, resulted in almost complete prostration at the Atlantic City conventions in June. He remained at Atlantic City for several weeks and then went to the sanitarium at Battle Creek, Mich., from whence he has recently returned. He is still under the care of physicians, but is greatly improved in general health.

C. H. Osborn has resigned his position as assistant superintendent of the car department of the Chicago & North



C. H. Osborn.

Western to become vice-president of the Mid-Western Car Company, of Chicago. Mr. Osborn was born at Westfield, Mass., March 31, 1875, and graduated in the mechanical engineering course at the Sheffield Scientific School, Yale University, with the class of 1895. He entered the service of the North Western, September 1st, 1895, and served a three-year course as special apprentice in the mechanical department, later filling the position of roundhouse foreman, division foreman, master mechanic and assistant superintendent of the car department.

As vice-president of the Mid-Western Car Supply Company, Mr. Osborn will look after mechanical matters, and will devote special attention to the development and sale of its one piece combination body and truck bolster.

H. F. Wardwell, at one time superintendent of power and equipment on the Chicago & Western Indiana, has resigned as assistant manager of the Central Locomotive & Car Works, Chicago, to engage in the railway equipment business on his own account, and has opened an office at 302 Railway Exchange building, Chicago.

The Grip Nut Co., Chiacgo, is enlarging its plant at South Whitely, Ind., and is installing 10 additional 6-spindle nut tapping machines.

The Griffin Car Wheel Co., Chicago, plans to enlarge its plant at Boston, Mass., by building an addition to the foundry, a new machine shop and auxiliary buildings. It is estimated that these additions will increase the present capacity by more than 200 wheels a day. This company will also enlarge its St. Paul plant, thereby increasing the capacity of that plant by more than 150 wheels a day.

The National Steel Car Co., limited, has been organized in Montreal with a capital of $6,000,000, consisting of $3,000,000 of 7 per cent cumulative preferred and $3,000,000 of common. The amount of stock issued as present is $1,500,000 preferred and $2,000,000 common.

Harry N. Turner has been made eastern railway representative of the Kay & Ess Co., Dayton, Ohio, succeeding D. L. Paulus, who died at his home in Atlantic City, N. J., June 20.

The American Car Screen Co. Pittsburg, Pa., has received orders from the Chicago, Milwaukee & St. Paul to equip nine sleeping cars and two observation sleeping cars with "Scotts" No. 2 adjustable car window screen. This company has also received orders to equip eleven new steel dining cars for the Pennsylvania.

The Stark Car Corporation, Strasburg, Va., has been incorporated in Virginia by C. H. Stark, and J. E. Eberly. The capital stock is $100,000.

Recent Railway Mechanical Patents

PATENTS.

CAR HEATING SYSTEM.

1,032,398—W. L. Garland, assignor to the Safety Car Heating and Lighting Co., New York.

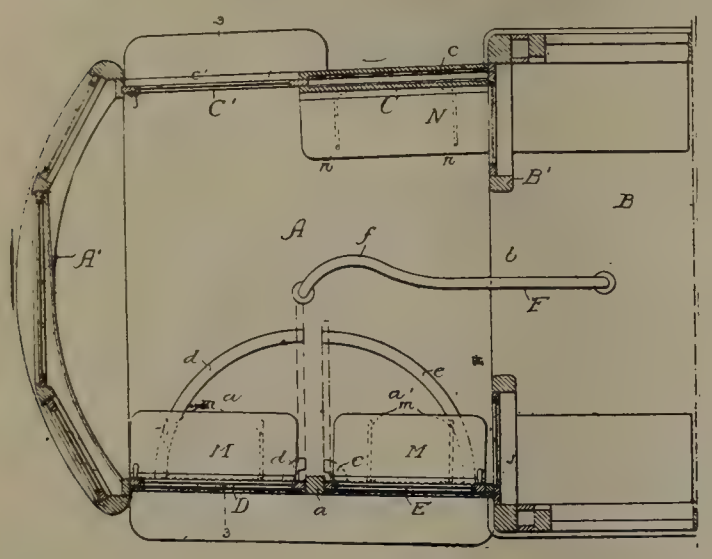
The combination with a car body provided with a window in one of its walls of a window sill associated therewith, a conduit within the car adapted to be connected to a source of supply of a heated medium and through which the medium is adapted to flow, and metallic means operatively associated with the conduit and the wall of the car adjacent the sill for causing the sill to be heated by the medium flowing through the conduit.

BAFFLE FOR WATER TUBE BOILERS.

1,032,697—F. O. Pahmeyer, assignor to Heine Safety Boiler Co., St. Louis, Mo.

A water tube boiler provided with a plurality of horizontal rows of tubes, baffle members, arranged upon the tubes of one of the horizontal rows, longitudinally extending ribs on the under sides of said baffle members provided with upwardly inclined ends, transversely extending ribs on the under sides of the baffle members which lie between the tubes of the row of tubes on which the members are mounted, and openings in the transverse ribs on opposite sides of the longitudinal ribs.

1,032,884.



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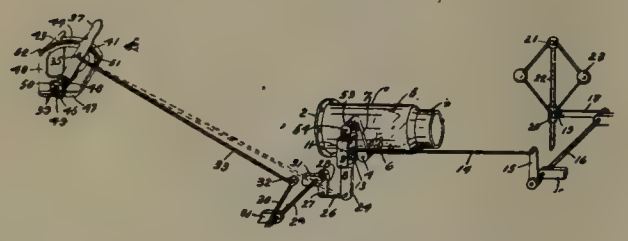


CAR COUPLING

1,032,751—B. M. Grate, Dayton, O.

A coupler comprising a coupler head, a lug formed thereon and having a recess provided with an inclined bottom, a knuckle pivoted in the head and comprising a toe portion adapted to interlock with the corresponding knuckle of an adjacent coupler and a heel portion having a flat face and an upper and a lower inclined face combined with a locking pin passing through an opening in the coupler head and engaging in the recess of the lug formed thereon, the pin having a diagonally cut lower face adapted to correspond with the inclined bottom of the recess and having a downwardly and rearwardly inclined upper face, a rearwardly inclined face, and a rearwardly and upwardly inclined bottom face, the faces converging toward a common point, and one side of the pin having a part cut away to form a recess to receive and engage the flat face of the heel portion of the knuckle and the side and rear faces having a part cut away to form a recess to provide a passage for the end of the heel portion of the knuckle.

PASSENGER CAR.

1,032,884—S. M. Curwen, assignor to the J. G. Brill Co., Philadelphia, Pa.

The combination in a passenger car, of a platform, a post at one side of the platform dividing the platform into ingress and egress sections, two doors hinged to the post inclosing the side of the platform, a gear wheel and two racks meshing with the gear wheel, one rack being pivoted to one door and the other being pivoted to the other door so that on the movement of one door the other will move.

EXTENSION STEP FOR PASSENGER CARS.

1,032,916—O. F. Lawson, New Sharon, Ia.

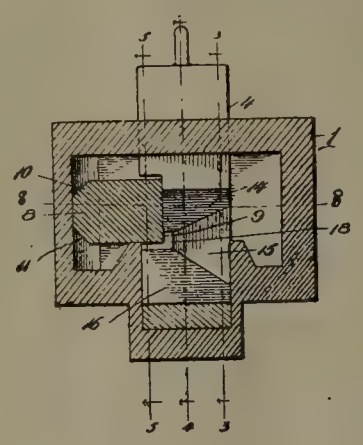
The combination with a permanent car step having a depending member at one side thereof, of an extensible step located beneath the permanent step and including a tread and a riser member, the members being pivotally connected with each other, a pivot rod supporting the riser member and having its extremities mounted in bearings in the depending member and car, respectively, a grooved roller supported by one end of the said pivot rod and disposed immediately below permanent step, a controlling lever, a horizontally disposed actuating rod connecting the lever and the riser member of the extensible step, and a flexible connection extending over the roller and having connection with the controlling lever and with the tread member for the extensible step.

NUT LOCK.

1,032,929—W. A. Moore, Garthersburg, Md.

The combination with a threaded bolt, of a nut adjustably mounted thereon, the nut being provided with threaded passages arranged tangentially with respect to the bolt receiving opening of the nut, the inner walls of the passages being provided with openings which are in direct communication with the bolt opening, oppositely extending screw threaded fastening devices wholly carried by the nut and arranged within the threaded passages and adapted to be turned so that the threads thereof will be moved into effective gripping engagement with the threads of the bolt, and each of the fastening devices being provided with a cavity intermediate its ends whereby the devices may be turned to a released position to permit adjustments of the nut on the bolt.

1,032,751



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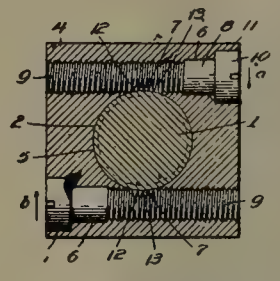

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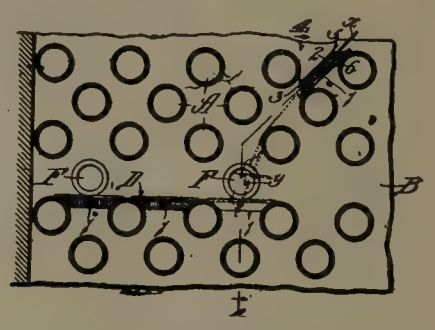

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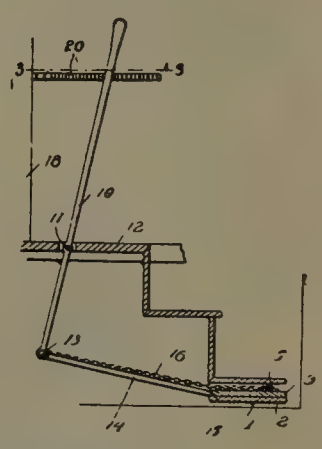


LOCOMOTIVE BOILER FURNACE.

1,033,008—J. H. Grove, assignor to the American Arch Co., New York.

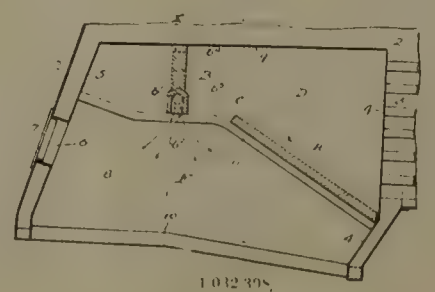
A locomotive boiler furnace comprising a firebox having a flue sheet at one end and a fuel door at the opposite end, in combination with a refractory front arch occupying an inclined position back of the flue sheet, and a hollow refractory vertical or crown arch depending from the top of the firebox back of the front arch and adapted to direct streams of hot air downwardly beneath the arches and toward the fire.

EXTENSION CAR STEP.

1,033,029—E. S. Mitchell and G. A. Campbell, Homer, La.

In an extension car step, the combination with the fixed steps of a bracket provided with means for connecting the same to the middle portion of the tread and riser of one of the fixed steps, an angularly adjustable hanger provided with a bushing for pivotally connecting the same to the bracket, a latch coöperating with the bracket to latch the hanger in various positions of adjustment, and a three-point support for the extension step including a swinging yoke substantially of U-shaped structure including a horizontal arm supporting bar and oppositely disposed vertical extending arm supporting bars connected to one of the stationary steps and carrying two arms connected to the swinging step, and a supporting arm connected to the swinging step and also connected to the latch.

1,033,008.



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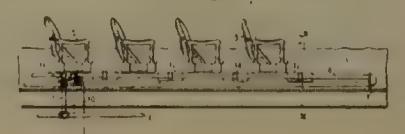

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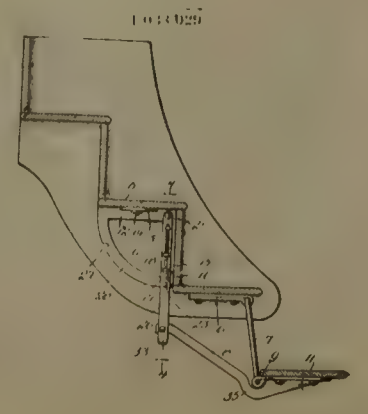

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The World's Greatest Railway Mechanical Journal
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CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.

In another part of this issue we print in full the proceedings of the thirteenth annual convention of the Chief Interchange Car Inspectors and Car Foremen's Association, which was held at the Palmer House, Chicago, August 27 to 29 inclusive. This association is interested in subjects which are peculiarly technical. The problems of interchange concern both the operating and mechanical as well as the traffic departments of the railways. Men in charge of large interchange bureaus must be diplomats as well as car experts. Their positions allow of endless differences of opinion, and their authority therefore should be unquestioned. Most of the association work is given to the detail solution of problems imposed upon the members by the Master Car Builders' rules. These rules do not, in every case, satisfy conditions. It would be, no doubt, of benefit to the railways as a whole if a little more attention were given these men who come in direct contact with the conditions, when the M. C. B. rules are made or revised.

LOCOMOTIVE INSPECTION AT TERMINALS.

Two elements in railway operation have tended to reduce the engineman from a mechanical expert to a mere runner or a starter and stopper. They are the pooling system of locomotive operation and the interference of his brotherhood in the detail work of his daily life. A locomotive of a thousand horsepower, more or less, is a complex and expensive mechanism which should have all the constant care the investment demands. The owner who would place a stationary plant of equal power in the hands of a man who considers his duties as ended when he has kept the wheels turning for eight or ten hours and who would then depend upon a bunch of machinists and wipers to fix up any difficulties entirely by guess, would be looked upon as one mentally deficient. This is what the railways are drifting into with evil results to the enginemen and themselves. The question was discussed at some length at the Traveling Engineers' convention, and it developed that most of the railways represented are concerned with this problem.

The pooling system is, no doubt, primarily responsible. All individual interest on the part of the engineman for his engine is lost when he is given a different engine each trip. The natural tendency is to get the train over the division, and if something radically wrong develops, to let the next man take the grief. This attitude is contagious, and is criminally destructive to company property. The pooling system is, however, a permanent institution. In spite of its disadvantages it is a necessary evil. An official of one of the large trunk lines stated that a return to the individual engine system would necessitate an increase of thirty-five to one hundred per cent in motive power. This, of course, cannot be considered for a minute. The best that could be done would be to remove passenger engines from the pool, as has been done on one or two railways with good results. This does not better matters very materially, however, because passenger enginemen are usually the pick of the availables, and the troubles experienced are not so evident among them.

The brotherhoods have been in error in their interference with the discipline which should follow any evidence of this careless spirit among members. A sense of security from any discipline except that which follows glaring infractions of accepted rules, is one of the assets of the brotherhood membership. This condition is one which works against the real interest of the men, as well as of the railways. The brotherhood, which by contract stipulates certain work on the road only and which fights attempts on the part of mechanical officers to secure from the men co-operation, at least to the extent of a detailed report of the condition of the engine in the terminal work book, is following a demoralizing policy.

The remedy lies in greater co-operation. Blanket work book reports should not be allowed. The co-operation of the engineman, to the extent of obtaining from him a careful detailed report of the condition of his engine, secured by a thorough inspection of the machine before he leaves it after each trip, must be insisted upon. Roundhouse foremen must be instructed never to discourage the enginemen in this part of their work, but must see that minor repairs are made as promptly as possible. The presence of the enginemen in the roundhouse for a certain part of their time between runs would be of assistance in securing the necessary co-operation. One master mechanic makes a practice of having the engineman, who turns in a faulty report, called to the roundhouse to be shown the results of carelessness in unnecessary work. The brotherhood officer who takes exception to this practice is not broad-gauged enough to represent an organization of men and should be dislodged.

THE PRESIDING OFFICER.

The success of a railway convention is of course largely determined by the efforts put forth before the convention assembles. The thoroughness of the committee reports, the care in selecting and arranging accomodations and the efforts made to obtain attractive exhibits are all essential features of a good convention and are the most important ones. When a convention assembles, it is the culmination of a great deal of hard work which has covered months, and which is brought to a climax in two, three or four short days.

The president is a man who holds his position because of his interest in his association and he, too, has his work to do before the convention is called to order. However, the greatest opportunity of the presiding officer, which is usually the president, is during the sessions of the convention. At this time he can do more than any other one man to increase its success. We have often seen a presiding officer whose voice could not be heard by half those in the convention and who seemed to be under the impression that he was up there to take orders from the convention, instead of running it. It is granted that not every man is gifted with a strong voice, but if he is to preside at a convention, let him exert his voice to the utmost, even if he is hoarse for a week afterward. It is up to the presiding officer to give and hold the keynote for the entire convention. Every man in the room should be able to hear every word he says and to know what is going on. Furthermore, it incites every member who gets on his feet to make himself heard and the tired members in the far corners will be compelled to take interest, even if they didn't expect to.

But making himself heard is not the only way in which the presiding officer can aid the convention. He should be thoroughly familiar with the papers to be presented and should acquaint himself before hand with the names of members who are interested in, or have done special work along certain lines, in order that he may call upon them. He should ask questions himself and take just as much interest in the discussion as if he were on the floor. Too many presiding officers seem to think that they are up there so that everyone else can talk to them. Then, too, in an association of any size, it is not possible for everyone to know everyone else and it is very likely that even the leading members are not recognized by the newer member or vice versa. When a man arises, the president should ask for and announce his name and the name of his road. It always helps some member and it gives more individuality to the man speaking. Other ways in which he may help are in calling the convention to order promptly and in seeing that discussions do not runn by the allotted time. He should see that members do not speak without the recognition of the chair and that one member is allowed to finish what he has to say before another one commenace. The success of the Traveling Engineers' convention at Chicago was due in a large measure to the efficient manner in which President Hayes presided. At one time when a number were taking advantage of a lull to leave the room he stated "I want you who are sent here by your railways to attend to business," and no better advice could be given to any convention. At another time he pointed to a somewhat noisy corner—"Can you hear over there?" "No!" "Well, then, keep still."

These are the things which a presiding officer can do to help the success of a convention. And in the last analysis, he must let the convention know that he is the most interested man there and that he is running the convention, not the convention running him.

TREATED WATER FOR LOCOMOTIVES.

The report of the Traveling Engineers' Committee on the subject of treated water for locomotives, with respect to its effect on locomotive efficiency, was not as complete as should have been expected. In the discussion several members were very anxious to secure data as to the cost of the engine tank method of chemical treatment. The answers covered only the cost of the chemicals used. This information should not be accepted as giving the figures required. There are several other considerations which must be given attention. With a soda ash treatment it was agreed that a large amount of blowing down must be done. No limit was placed on the periods of opening of the blow-off cocks, but it was recommended that enginemen be instructed to use the blow-off cock frequently. In blowing off boiler water, to decrease the foaming tendency, it is quite possible to waste a considerable amount of fuel in a trip. The cost of this fuel must be added to the cost of the treatment, in so far as the treatment alone makes blowing off necessary.

CORRECT REPORTS.

The saying, "Be sure you are right; then go ahead" has no better application than to the field of reports and tests. Deductions drawn from tests carelessly and improperly made are worse than no deduction at all. We base our reasons for the adoption of certain methods and certain devices, on tests and experiments which we or others have carried out. How important it is that such tests be made with utmost care and that the reports be thoroughly checked before being made public. Committees sometimes make reports which have been hastily thrown together at the last minute and which are then given to the public as authoritative. It is better that such a committee make no report at all.

You will occasionally hear men say that such and such a device effects a saving of 25 per cent or 50 per cent. Such a statement is of little or no value unless it has figures to back it up. If a device or method is worth adopting, it is worth testing to see what it is doing for you. Your conditions may be different from the other fellow's, and every factor should be carefully considered, so that when you present your report you can give exact figures, and what you say will mean something. A report either individual or by a committee should be checked over so carefully that no man is going to be able to get up and show you where you made a mistake, either in your manner of testing or of computing. There are too many committee reports which are the result of hastily throwing together the information at hand without checking it over thoroughly or without obtaining complete reports.

In a paper presented before a prominent railway club, the question of latent heat of water was involved, and the author neglected entirely to take into consideration a certain factor which made a great difference in his results. A number of members "landed" heavily on the paper and, as a consequence, the paper, which was otherwise a good one, was discredited in the minds of many. We are looking for exact figures today. We are not going to accept a man's statement that a device is good or bad unless he proves it to us in a logical way.

During the course of his talk before the Traveling Engineers' Association B. A. Worthington, president of the Chicago & Alton, related an incident which occurred after he had gone west to take charge of the Oregon R. R. & Navigation Co. He was familiar with the Stephenson valve gear, but at one station he noticed an engine with a Walschaerts gear, which was just being introduced at that time. So he stepped up to the engine to examine it closer and asked a question of a man in blue overalls standing by. This fellow proved to be a car inspector and was unable to answer the question, but he stepped over to the fireman, who was leaning out of the cab, and said: "Hi, Jimmy, come down here; this is the new general manager and he wants to know something about railroading."

The Equipment Men

By Berton Braley.

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Dedicated to the 1911-1912 officers and members of the executive committee of the Railway Equipment Mfrs. Assn.

It now behooves the muse to sing
Of men who make most everything
That Engineers and firemen, too,
May use in any work they do;
Of valves and grates and tubes and jacks,
They manufacture stacks and stacks;
And all their livelihood they gain
Equipping motive power and train,
With every sort of new device
In every shape and every price.

J. Will Johnston (House of Pyle),
Rests himself in pleasant style,
Wandering the foreign strand,
With a headlight in each hand,
While he stays "Across the foam"
They will miss him, here at home,
They can scarcely be content
Lacking for a president.

F. D. Fenn, who works for Crane
Hides himself behind a hedge
(Of this foliage he's vain
So, at least, his friends allege),
'Spite of this they will insist
He is quite a humorist.
Canny treasurer is Fenn
Of these keen Equipment Men.

"Billy" Allison, poor chap,
Has the "Secretary's snap",
Meaning—truly have they said it—
"All the work and none the credit!"
Billy at an earlier day
Labored for the Santa Fe,
Now he's with "Equipment Guys"
Selling Franklin Co.'s supplies.

"Ach du lieber, Charlie Shults!"
He's a whale at selling steel,
Himmel! but he gets results,
Such a speech as he can spiel!
Worth, New York, is Charlie's firm,
He's been with them quite a term.

Frank A. Morrison we know
As the man who represents
Mason Regulator Co.
With an energy intense;
B. J. Neely blithely sells
Valves for Jenkins Brothers' plant,
And you bet his effort tells

(Watch the other fellows pant!)
Also here we pause to note
W. Schlacks—a hustler he
Busy as a mountain goat
For McCord and Company;
Next we show that son of toil
P. H. Stacks (Galena Oil).
He, who pours, with care unsparing,
Oil on many a troubled bearing;
Then we close this noble list
With that happy optimist
Frank H. Clark—who dreams so much
Of Watson-Stillman valves and such!

And so the muse has sung her song
And tried to make it brief, but strong,
A lyric that should thrill again
The souls of all Equipment Men,
There wasn't room for all the gang
So only officers she sang,
And if you miss a name or face
Remember that she lacked for space.

Yards and Terminal of the Philadelphia and Reading Ry. Co. at St. Clair, Pa.

By P. S. Lewis.

An important extension of facilities for the handling of coal traffic is being made by the Philadelphia and Reading Railway Company in the construction of fully equipped yards for the weighing, classification and making up of coal trains at the western terminus of the Reading division between the towns of St. Clair and Port Carbon, Schuylkill county, Pa. The topography at this point is peculiarly adapted to the location of such a yard. The tracks cover the area of a flat valley about two miles long and one thousand feet wide, through which, and without the use of a prohibitive amount of embankment or excavation, it has been possible to maintain approximately a 1.2 per cent grade, from the lower to the upper end of the yard, so that all south bound, or loaded cars or trains, are shifted entirely by gravity. This natural grade has eliminated the necessity of a hump for the classification of the loaded coal cars, and has not proved a serious drawback in handling northbound traffic, which consists almost entirely of light cars returning to the mines.

Coal Handling Facilities.

The track system, of what may be termed the south bound portion of the yards, consists of a receiving yard, track-scales, classification yard, departure and inspection tracks, and is used exclusively for the handling of loaded coal cars. From the receiving yard of eight tracks, with two hundred and eighty cars capacity, the trains are broken up and the cars dropped singly into the classification yard, a brakeman being assigned to each car. During this movement, which classifies the cars according to destination, the coal is weighed as it passes over the track scales, located at the upper end of the classification ladders. This is a sixty foot scale of the ordinary type, designed to weigh cars in motion, and is equipped with a dead track, which allows cars to pass over, when required to do so, without interfering with the mechanism of the scale.

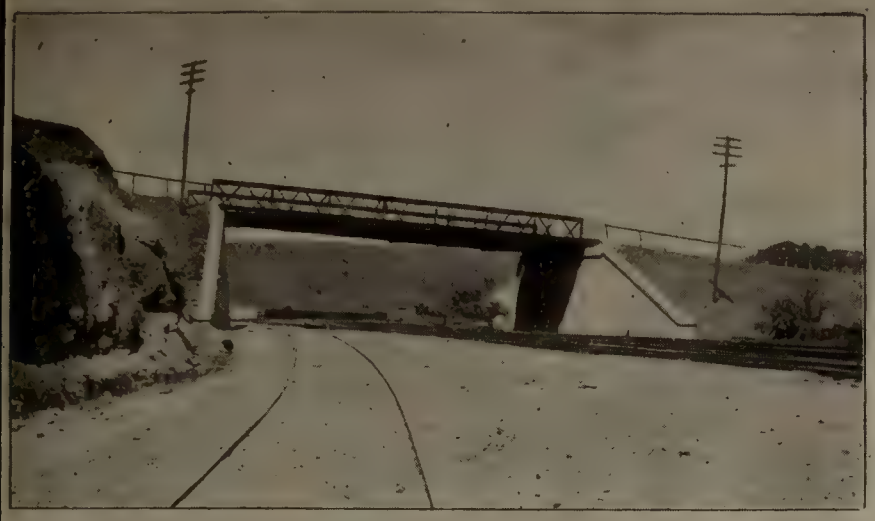
An idea of the working capacity of, and volume of traffic handled by, the south bound portion of the yards, may be gained by an observation of the table below, showing the number of cars and tonnage of coal which passed over the scales during January, February and March of the current year, together with the number of shifts worked and the number of main line trains in which these cars were sent from the departure yard:

	No. of Cars.	Tons of Coal.	No. of Shifts.	Av. No. of Cars per hour.	No. of Trains
January	26,432	778,087	28	78	411
February	29,177	784,548	28	86	448
March	33,129	935,284	30	92	504

From the classification yard of 35 tracks and 1,525 car capacity, the cars are dropped in drafts of 10 to 65 and are assembled in trains on the inspection tracks of the departure yards. These 9 tracks, spaced 15-foot centers, and piped throughout with air at 110 pounds, have a capacity of 75 cars each with engine and caboose. Before leaving this yard the trains undergo a thorough inspection and are put in perfect condition for main line movement. All air-brakes are tested to withstand a pressure of 110 pounds, after which it is reduced to 90 pounds (that carried by the engines), and all trains leave charged with 100 per cent air. In addition to airbrake inspection and repairs, all journals, brake bars and safety appliances are inspected and such minor repairs made as may be found necessary. During March, 1912, there were 27,134 cars inspected and sent away in 504 main line trains. Of this number 6,989 were foreign cars. In addition to the many minor repairs to journals, safety appliances, brake bars, etc., others made during March were: 750 triple valves and cylinders cleaned, and 1,146 air brakes repaired.

Light Traffic Handling Facilities.

The north bound portion of the yard provides facilities for the receiving and repairing of empty cars and for the making up of trains for their return to the collieries. The receiving yard of 9 tracks and 585 car capacity is parallel with and opposite to the south bound departure yard. After an inspection in the receiving yards, the cars are shifted by pushers to the departure yard, the light repair tracks, or the shop tracks, according to the repairs found necessary. The departure yard and light repair yard, which is also used as a departure yard, have 6 tracks each and a total capacity of 420 cars. Construction of the proposed repair shops has not yet been commenced, but it is the intention to start this work in the near future. They are to provide, in addition to other equipment, two cranes for the lifting of empty cars and one for the lifting of loaded coal cars which may be in need of repairs. The north bound track system has, with the exception of these shops and the shop tracks, been completed, and during the months of February and March, 18,710 and 21,086 empty cars, respectively, were handled over it. Between the north bound departure and south bound receiving yards there are four tracks for the storage of engines, with a total capacity of 35 engines. A caboose track at the upper end of the south bound departure yard is so located that cars may be placed on, and removed from it, in order of their arrival, the cabooses being dropped by gravity to the rear of the departing trains. There is a loop track around the engine house from the north bound receiving to the south bound departure yard, allowing a quick movement of engines between these yards without the necessity



OVERHEAD BRIDGE AT RUSSELL STREET.

OVERHEAD BRIDGE AT DORMERS.

REINFORCEMENT OF ROUNDHOUSE ROOF SLABS, ST CLAIR ROUNDHOUSE.

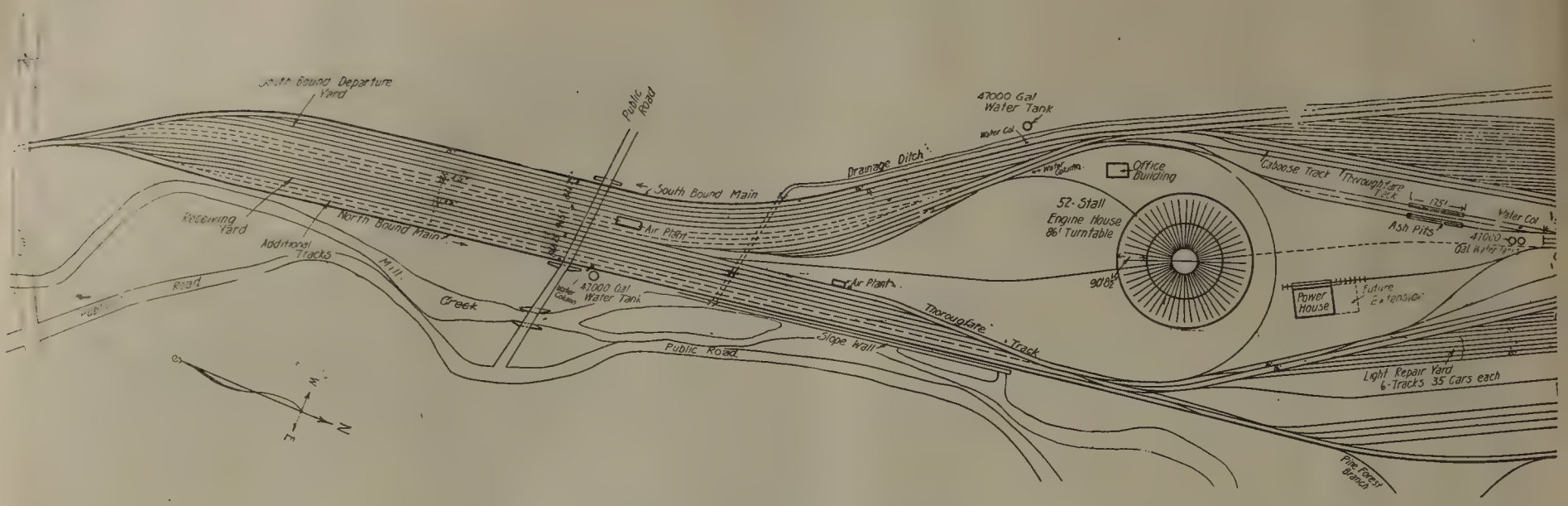
NORTH APPROACH TO DORMERS BRIDGE AND ARCH OVER MILL CREEK.

PART OF COALING STATION AND NORTH BOUND ASHPIT.

PORTION OF SOUTH BOUND CLASSIFICATION YARD.

EXTERIOR WALL OF ROUNDHOUSE AND FAN HOUSE.

TURNTABLE PIT, ST. CLAIR ROUNDHOUSE.



Layout of St. Clair, Pa., Yards, P. & R. Ry.

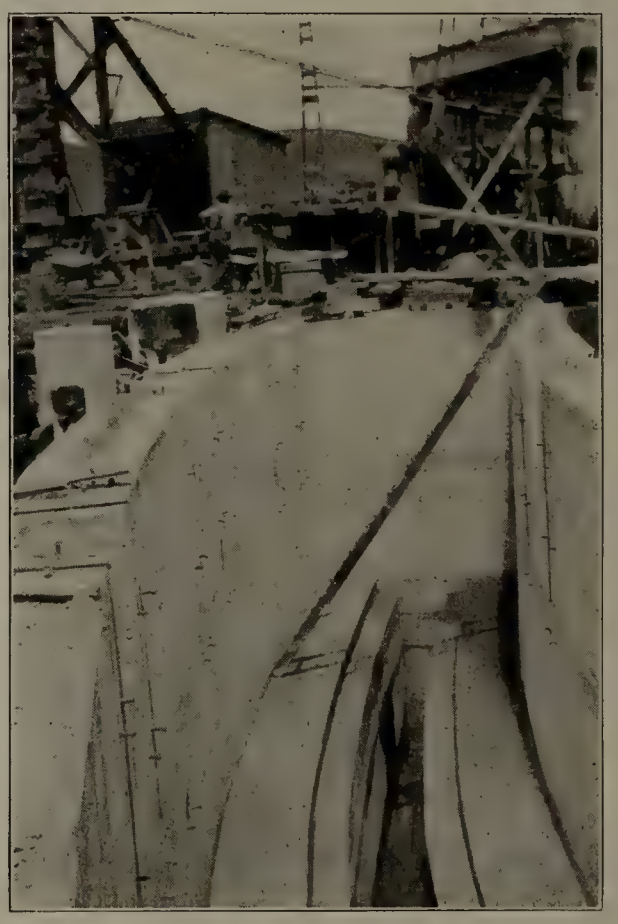
of going on the turntable. The north and south bound main tracks separate at either end of the yard and run outside of all yard tracks, reducing to a minimum the number of frogs and switches required on the main line tracks.

Buildings.

At the upper end of the south bound departure yards the north and south bound track systems separate, forming a wye and affording a site for the new engine house, power house, office building, coaling station and ash pits. There is no transfer or freight station, as provision is made in these yards for the handling of coal only.

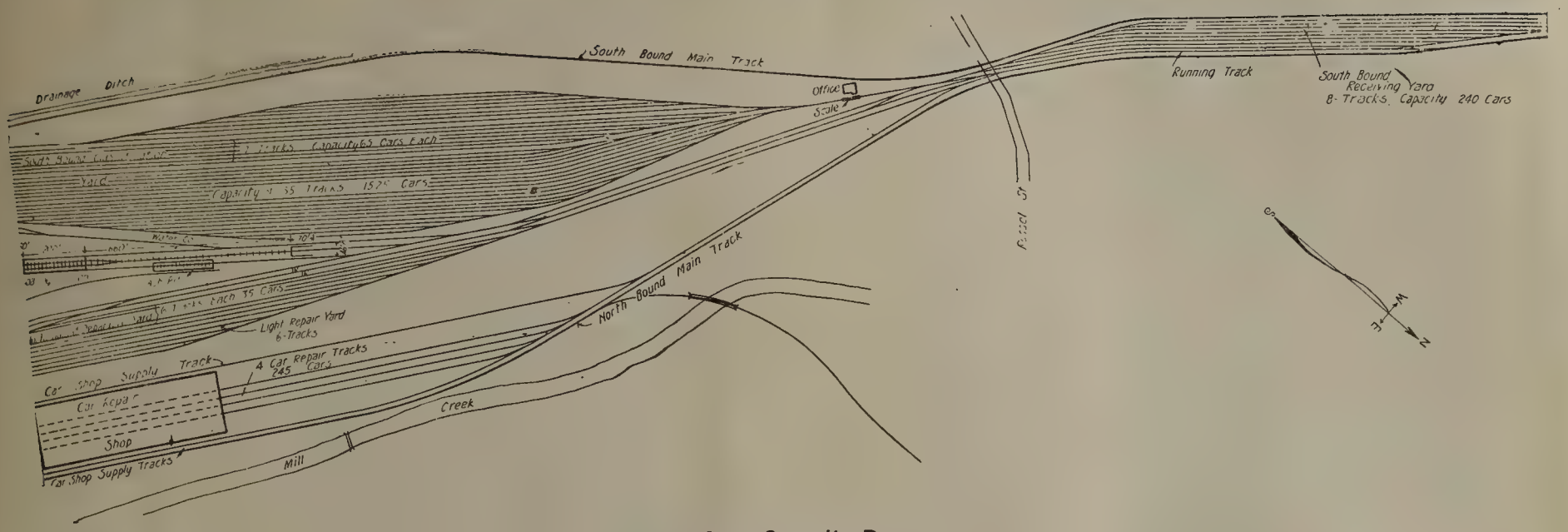
The engine house, which is nearing completion, is a circular structure of reinforced concrete; inner radius 107′ 8½″ outer radius 198′ 4⅜″, making width of building 90′ 8½″ between columns. There are in all 52 bays, the angle between tracks being 6° 55′ 23″. Thirty-three of these bays are provided with engine pits, two are taken up as passage ways, and the remaining seventeen are to be used at present for a machine shop. However, their design is such that they may be converted into engine pits as the demand may arise.

The engine pits are 65 feet long, with walls and convexed floors of concrete; the rails, which are tie-plated, are carried on 8x12-inch creosoted yellow pine stringers. The length of stall along the centre line is 90 feet, the locomotive standing normal with the tender towards the turntable.



Showing Construction of Drop Pits at St. Clair.

St. Clair Roundhouse, P. & R. Ry.



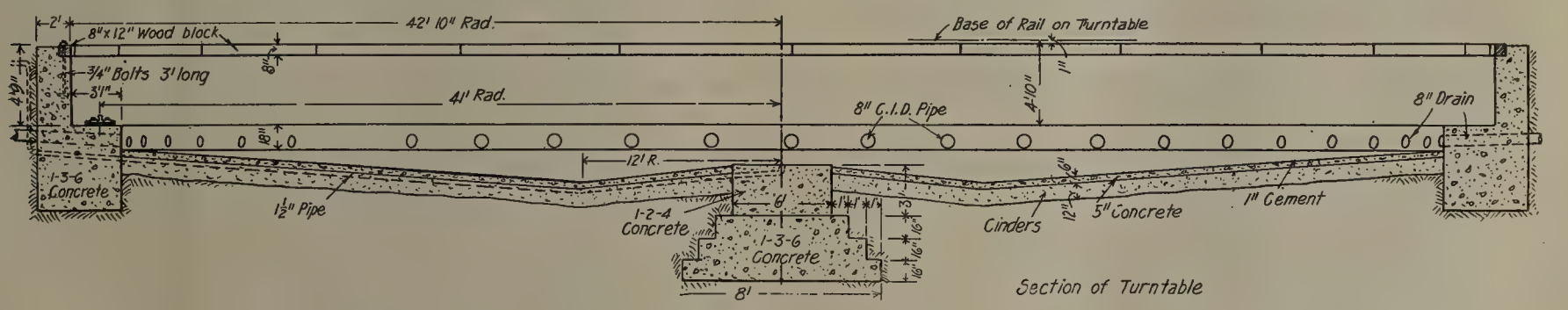
Continuation from Opposite Page.

In the centre of the house there is an 85-foot deck girder turntable operated by electricity, the power being transmitted through the pivot. The pit for this turntable is constructed of concrete with an 8x12 inch white oak coping. The engine pit drainage and that from the two inner sections of roof discharge into the turntable pit through an eight-inch pipe at each bay, the turntable pit being drained in turn by a 24-inch pipe to the general drainage system of the yard.

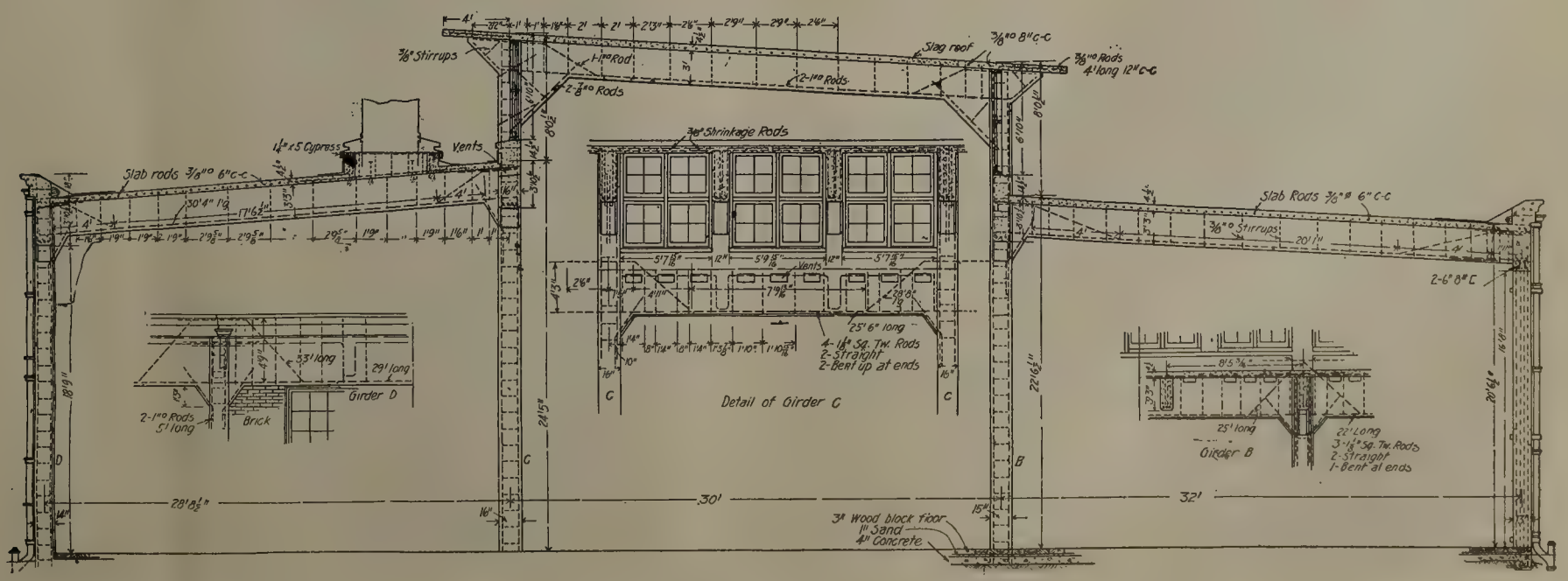
The superstructure consists of a system of concrete girders, beams and roof slabs, supported by series of four columns each, on radial lines between stalls. The columns are reinforced with longitudinal bars and hoops; the beams and girders with a combination of the horizontal bar, stirrup, and the bent-up bar. The roof slab is reinforced with round bars running in two directions perpendicular to each other, and is covered with a four-ply slag roofing. The superstructure is built in three sections, the centre section overhanging the inner and outer sections and is raised about seven feet above them, affording space for large lantern windows which are 8' 10"x5' 8". The outer wall of the building is of red brick with a 15' 10"x15' 6" window frame between the concrete columns of each bay. The entrance doors, which swing inward, have a 4' 5"x8' 5" window frame in the upper part of each door, and every third bay is provided with a small door within the larger one. The number and size of these windows assures an abundance of light within the building.

The floor in the machine shop and between pits is of creosoted long leaf yellow pine blocks laid on a 4" concrete foundation and 1" sand cushion.

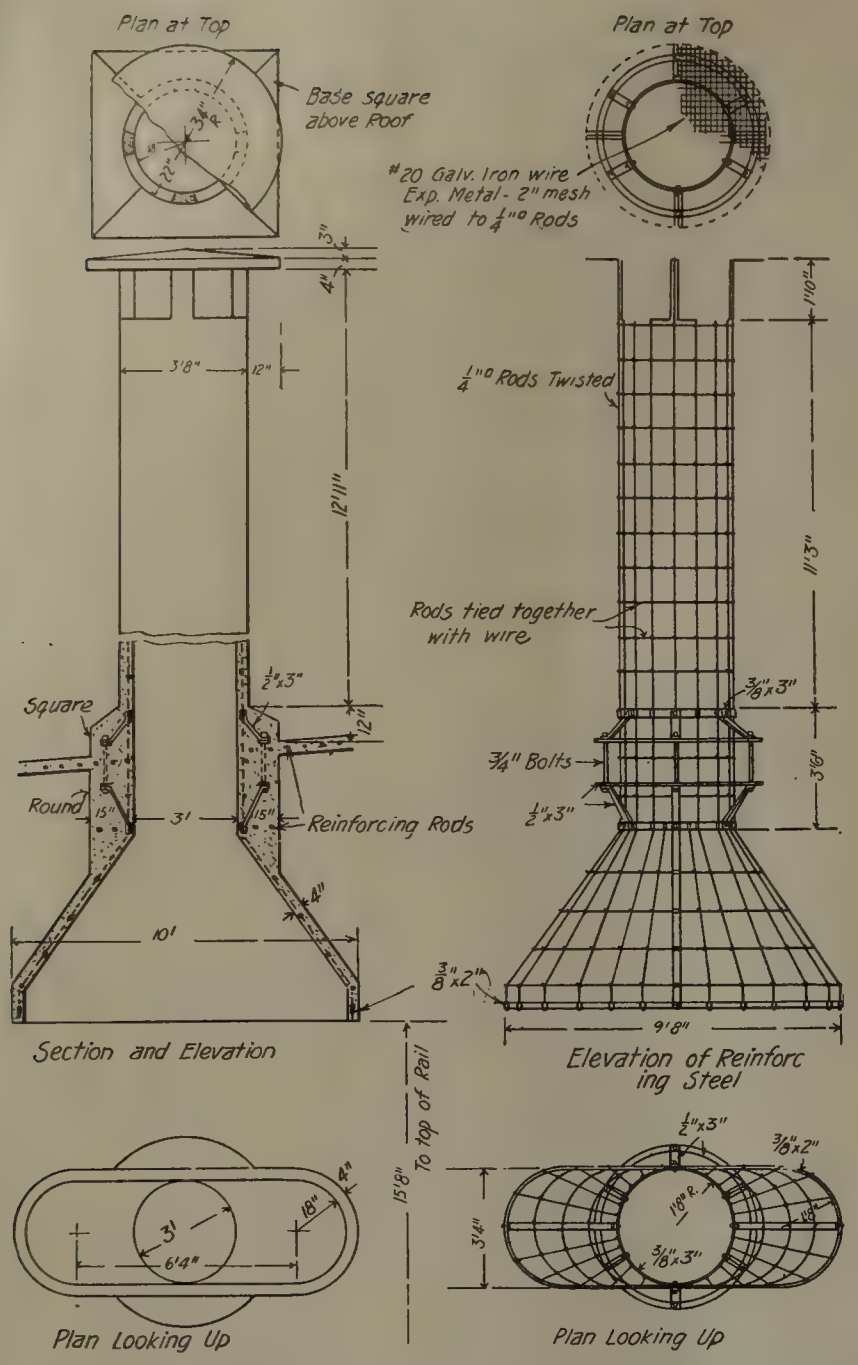
The engine house is heated with hot air, by means of a fan heating system consisting of equipment placed in three fan houses outside of the building proper and built as an extension to the concrete superstructure of the main building. The fan houses are 24 feet long, the width of one bay at the outer wall being 22 feet, and are designed with beams, girders and slabs similar to the main superstructure. Beneath the floor and encircling the entire building just within the outer wall is a hot air and pipe duct 4 feet 8 inches high and 7 feet 6



Section Through Turntable Pit.

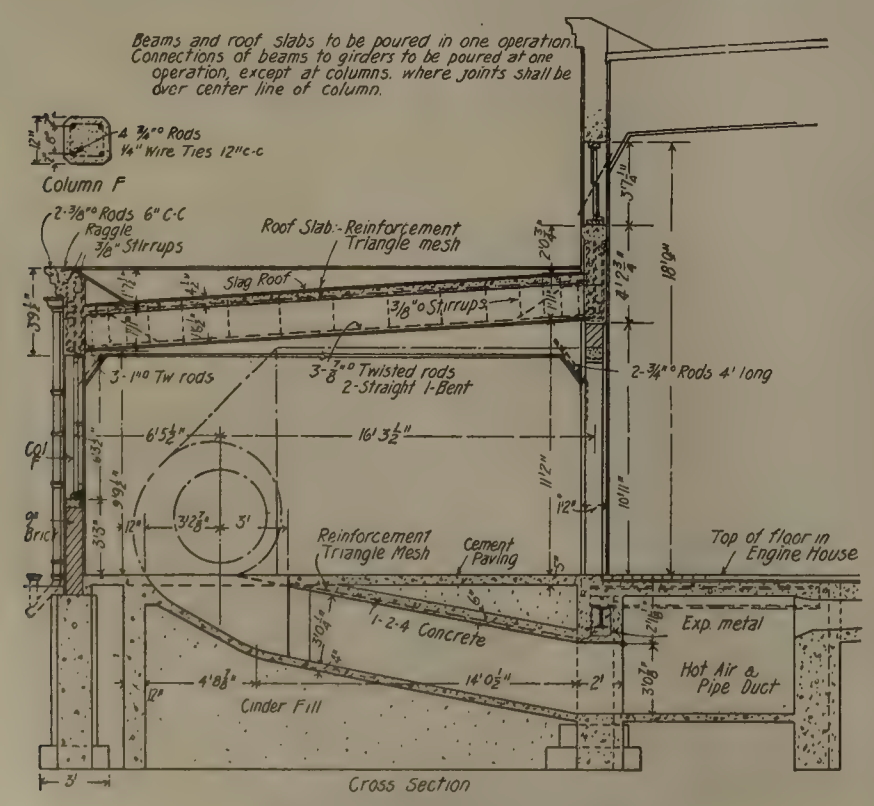


Section and Details of St. Clair Roundhouse.



Details of Concrete Smoke Jack, St. Clair Roundhouse.

inches wide, which delivers hot air to the machine shops through registers in the wall, and to the engine house proper through an air shaft at each engine pit; the hot air being delivered to the engine portion of the locomotive. For driving the air through this duct there are placed 120 degrees


Beams and roof slabs to be poured in one operation. Connections of beams to girders to be poured at one operation, except at columns, where joints shall be over center line of column.
Column F
Roof Slab - Reinforcement Triangle mesh
Slag Roof
Reinforcement Triangle Mesh
Cement Paving
Top of floor in Engine House
1-2-4 Concrete
Exp. metal
Hot Air & Pipe Duct
Cinder Fill
Cross Section

Section Through Fan House.

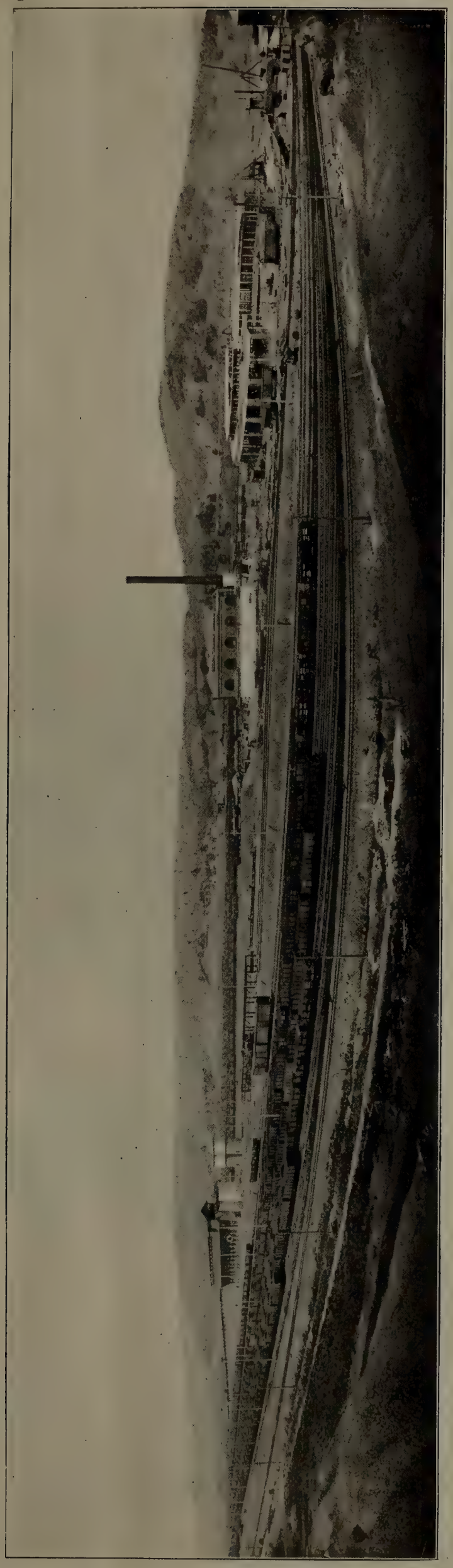
apart in the fan houses, three 90-inch double inlet steel plate fans, capable of delivering at 350 R. P. M., 47,000 cu. ft. of air per minute against a pressure of 1½ inches of water. Each fan is operated by direct connection to a 35 H. P., 3 phase, 25 cycle, 440 volt, squirrel cage induction motor, at 350 R. P. M. The heating system, which is operated by exhaust steam, and arranged for vacuum returns from the drip side of the heater coils, consists of three sets of heater coils, each of 7 sections of 1-inch pipe. The air duct also carries an 8-inch water supply line, and 3-inch lines of steam and compressed air. From these lines, and at alternate spaces between stalls, there are hydrant boxes providing 3-inch taps from the water line, and 1½-inch taps from the air and steam lines, the piping between the duct and hydrant boxes being through an 18-inch terra cotta pipe beneath the floor.

Similar to the fan house construction there is also an extension to the building proper through four bays providing for the installation of a boiler wash system, where the blow-off from boilers may be carried to large tanks below the floor and used for heating, refilling and wash out water. In addition to a blow-off steam separating tank, where steam is used for heating engine filling water, the equipment provides a series of water storage tanks placed in concrete pits beneath the floor of the wash room. These tanks receive the blow down water from locomotives, as well as all boiler washing water, which returns from the engine pits, through a filtering device to a receiving tank which is in direct communication with the tanks receiving boiler wash down water. The boiler filling water tank is in direct communication with the return water tank and the blow down tank, through a filter box. For boiler filling and washing there are provided two centrifugal motor driven pumps, discharging through plugs located at the pits of the engine house.

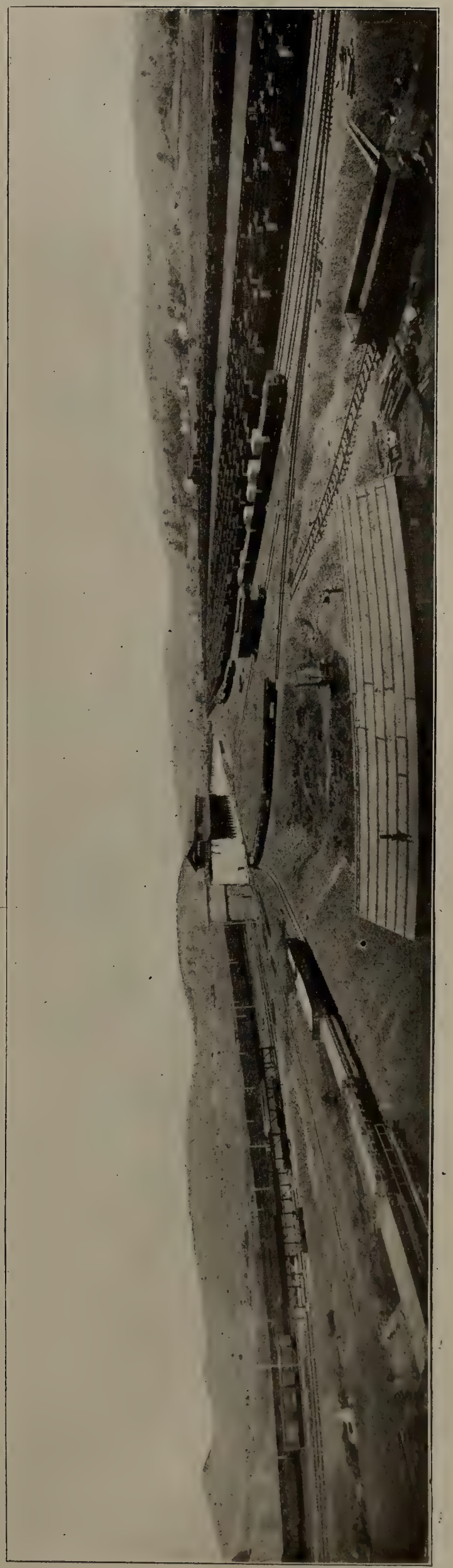
For the handling of tender and engine truck wheels there is provided a drop pit running through three of the engine pits, the center of the drop pit being a circumferential line 22′ 6″ from the center of the inner columns. The wheels may be lowered by electric driven screw jacks to a truck running on a narrow gauge track in the pit below. This truck may be pushed to an adjacent engine pit, the wheels raised and run off on the tracks of the engine pit. A similar drop pit for the handling of driver wheels, the center line of which is 51′ from the center of the inner columns, runs through four of the engine pits, the two drop pits occupying but one stall in common.

In connection with seventeen cast iron smoke jacks of the usual type, there are to be installed seven jacks of reinforced concrete, it being hoped that this new style of jack will solve the question of obtaining a noncombustible and noncorrosive material for the construction of smoke jacks. Their construction is shown in the illustration. Their simultaneous use under similar conditions will offer a fair comparison of the relative efficiency of these two patterns.

The new power house, located between the proposed shops and the engine house, is about 145′ from the latter and connected with it by means of an underground tunnel 6′ high and 4½′ wide, inside measurements, and provides a passage for steam and air lines and allows working space around the pipes of these lines. The power house is 127′x 95′, with structural steel frame and brick walls; floor and roof slabs are of reinforced concrete. Outside of the building there are concrete coal bunkers, crossed by an inclined concrete and steel trestles approach for the hopper cars which dump their contents into the bunkers. From these bunkers the coal passes through chutes into the boiler room, and will be deposited directly in front of the boilers. The boiler equipment consists of four 308 H. P. water tube boilers, with economizers, and equipped with shaker grates for fine anthracite coal. Drafting for these boilers is secured



View from the West, St. Clair Roundhouse and Yards During Construction.



Progress View, St. Clair Yards, November, 1911.

by means of breeching opening into a brick smoke flue, located over front of boilers, and leading to a steel brick lined stack outside of the building. This stack is 150 feet high from grate to top, with inside diameter of 7 feet 6 inches. In connection with this stack there is forced draft equipment provided in the form of a double inlet housed blower, connected by means of suitable ducts and draft grates with the ash pits of the boiler settings and operated by direct connection to a vertical, self-oiling engine.

Each boiler is connected to the main steam header by a loop and controlled by an 8-inch automatic stop and check valve. Boiler feed water is supplied from an 1,800 H. P. capacity feed water heater, through 14 x 18 x 12 outside, end packed, plunger pumps, arranged in duplicate. The boilers are hand fired, and ashes removed by means of a pneumatic ash hoist receiving buckets, which run on a narrow gauge track in an ash duct below the floor in front of the boilers.

The engine room, which is served by a 12½-ton overhead traveling crane, contains two horizontal, cross compound engines of 600 H. P. each, and operating at 150 R. P. M. They are directly connected to two 500 K. V. A., 3,300 volt, 25 cycle, 3 phase, revolving field alternators, capable of operating on parallel or single. Directly connected to a 10 x 14 horizontal engine there is one 50 K. W. exciter, 125 volts, direct current, compound wound, operating in parallel or single at 250 R. P. M. There is one 50 K. W. motor driven exciter, compound wound, 125 volts, direct current, operating in parallel or single at 900 R. P. M., the motor operating on 3,300 volts, 3 phase, 25 cycle, with auto starter. Two sets of frequency changers are provided and consist of 50 H. P., 720 R. P. M., 440 volts, 3 phase, 25 cycle induction motors, direct connected to 2,200 volt, single phase, 60 cycle generators, the two sets operating in parallel and the motors operating on 3,300 volts, 25 cycle, 3 phase at 720 R. P. M. There are also six 15 K. W., 25 cycle, 3,300 to 440 volt oil cooled transformers.

A distribution tower has been provided to arrange for separate wire compartments for all wires leading to distributing circuits, each wire being independent and separated from other wires by brick work barriers 4 inches wide and 9 inches deep.

Outside of the building there are cylindrical air receivers arranged in tandem, with outside pipes, and supplied by two steam driven air compressors, each having a capacity of 1,700 cu. ft. free air per minute compressed to 125 lbs. gauge pressure.

A complete electric lighting system for the yards and various buildings is included in the equipment of the power house, but as none of the several proposed schemes have as yet been adopted it must suffice to say without going into detail, that current will be taken from the main generators through transformers especially designed for this work.

At the head of the south bound departure yard and to the southwest of the engine house there is a new three-story office building 65′x41′. The frame is of structural steel, walls of red brick, with interior finishing of chestnut. In addition to offices for the assitant train master, master mechanic, train dispatcher, and their clerks, the building provides comfortable quarters for the thorough-crew which may be laying over night awaiting a return trip. On the second floor there are pleasant game and reading rooms, lunch room and a fully equipped kitchen; the third floor being devoted to dormitories and locker room, shower baths and toilets.

To the north of the engine house and between the classification and the north bound departure yards there is a new coaling station of the trestle type of 950′ incline approach of structural steel carried on concrete piers spaced 20′ centers. There are two tracks for the hopper cars over the bunker portion of the coaling station, the bunker providing for the storage of about 1,200 tons of coal, which is delivered to the locomotives by 16 chutes on either side of the dock.

In connection with the coaling station there is a sand-drying room in which the sand is dried and carried overhead by compressed air into bins, from which it is run directly into the sand boxes of the locomotives.

Just below the coaling station there are two water towers, each of 47,000 gallons capacity. These towers are supplied by an 8″ pipe and three feed water columns placed in convenient locations for north and south bound engines on their way between the engine house and the coaling station.

The south bound ash pit is located on the running track between the coaling station and the south bound departure yard. It consists of a system of three tracks, the outer two of which cross pits 175′ in length. The ashes are deposited into these pits and received in small all-steel cars running on narrow gauge tracks within the pits. These cars are later lifted by an overhead crane and their contents dumped in steel cars standing on the track between the two pits.

To form the north bound ash pit the running track to the coaling station is carried on steel girders over a number of brick piers for a distance of 192′ between abutments. The ashes are dropped to a brick platform and from there shoveled to cars standing on a depressed track below, which is constructed with a retaining wall on the ash pit side to retain the filling of the running track. In the case of both ash pits the tracks are open at either end, so that engines may leave in the order of their arrival, and the arrangement is such that they may take water, sand and coal, and deposit ashes in convenient rotation on their way to and from the engine house.

At the upper end of the classification yard there is a new two-story scale office of red brick 47′x43′, which provides for the operating device of the track scale as well as offices for the yard master, weigh master and shipping clerks. This building, as well as that at the lower end of the yard, is heated by hot water, they are roofed with asbestos shingles and their floors have been treated with creosote oil.

The plans for building equipment were prepared in the office of S. G. Thomson, superintendent of motive power, the work being directed by C. A. Bingaman, engineer of tests.

Drainage.

When the track work of the new yard was first commenced, the land of the entire valley was of a very swampy nature and it was first necessary to devise some system of drainage which would dispose of this swamp water, with which the ground throughout the whole valley was saturated. This has been fully accomplished by the construction of an open drainage canal, 8.5′ wide and 3′ high, which runs from the lower end of the south bound receiving yard, along the west side of the yard, as far as the Dormers bridge, a distance of some six thousand feet, where it enters a concrete culvert 4′x10′, and runs under twenty-one tracks, discharging into Mill Creek at a point near the middle of the north bound receiving yard. This canal drains practically all of the surface water, the ground water being disposed of by a terra cotta line through the centre of the yards from the north end of the coaling station to a point below the engine house, where it drains into Mill Creek. At its beginning this is a 12″ line, and increases to 18″ and 24″ lines after having received the storm drainage of the coaling station and that of the two ash pits respectively. The 24″ line receives the drainage from several water columns as well as the storm drainage from the power house, and is increased to two 30″ pipes, laid in concrete, below the point where it unites with the storm, pit and sewerage drainage from the engine house and office building. This

sewerage first passes through two septic tanks and a filter bed, which lie to the south of the engine house.

Water Supply.

The water supply for the yards is furnished by the Silver Creek Water Company, which has a 12" main at approximately 250 lbs. pressure, running along the west side of the yard. From this main there is an 8" line to the engine house and power house, from which there is a 1½" tap line to the office building. The two water towers below the coaling station are fed from this main by an 8" pipe, which also supplies the water used at the two ash pits.

The plans for this terminal were prepared in the office of William Hunter, chief engineer, who placed the work in the hands of Jos. S. Ward, resident engineer at Williamsport, Pa. Mr. Ward's assistants on the ground, in direct charge, have been W. N. Boyer, and later P. S. Lewis. The C. P. Bower Construction Co., of Philadelphia were the general contractors.

Traveling Engineers' Convention

The Traveling Engineers' Assn. held its 20th annual convention at the Sherman Hotel, Chicago, August 27, 28, 29 and 30, 1912. The attendance was the largest in the history of the association and the committee reports were discussed with such interest as to necessitate afternoon sessions each day, in order to keep up to the program. The convention was presided over by its president, W. C. Hayes. superintendent of locomotive operation of the Erie R. R.

TUESDAY, AUGUST 27.

Dr. Kennedy Marshall of California opened the convention with prayer, after which S. O. Dunn, editor-in-chief of the Railway Age Gazette gave an address on the subject of, "The Interest of Railway Employees in Efficiency." He called attention to the attitude of many labor unions and workingmen towards labor saving machines and other methods of increasing efficiency; many being of the opinion that they tend to decrease the amount of work available. In answering this argument Mr. Dunn presented a theoretical case tending to show that greater efficiency would lessen the cost to both employee and employer, and would result in a larger return to both. This analysis was then applied to the railway field to show how a get-together spirit would produce better results for all concerned.

Mr. Hayes delivered the president's address, in which he urged co-operation and organization in the work of traveling engineers and train crews. He also said that each engineer should be able to understand the voice of his engine; that each engine had a way of telling whether or not all was well and that a competent engineer should immediately be ready to recognize a note of distress. The smoke abatement question and agitation also came in for a share of attention and Mr. Hayes stated that engine crews should be urged to give the matter greater attention not only from the standpoint of city ordinances but from the standpoint of fuel economy as well. He suggested that this subject be thoroughly investigated and reported upon. In conclusion Mr. Hayes spoke of the qualifications of the successful traveling engineer, mentioning resourcefulness, punctuality and self reliance and gave W. O. Thompson, the secretary, great credit for the success of the conventions.

Mr. Thompson then read a sketch of the history of the association, which is as follows:

History of the Traveling Engineers' Assn.

"A short time after the adjournment of the Master Mechanics' and the Master Car Builders' conventions in 1892, a road foreman of engines, of one of the prominent lines running into Chicago, listened to a conversation between a representative of the Westinghouse Air Brake Co. and his own master mechanic relative to the good work that had been done at those conventions and how much benefit it was for a man in the railroad business to meet other men in the same business from all parts of the country for the purpose of exchanging views, experience, etc. The conversation between the above mentioned gentlemen caused their listener to think that if the Master Mechanics' convention was of such inestimable value to that class of men, that an association of traveling engineers would be of even more importance, not only to the traveling engineers, but to the heads of the mechanical departments as well. Acting on the thought at once, he started out to find traveling engineers in sufficient numbers to form an association, and strange as it may seem, as at the present time a member by referring to his latest annual report can find over six hundred names and addresses of traveling engineers, he consumed over three months' time in getting the names of fourteen traveling engineers who were enthusiastically in favor of the idea. Seven of these have gone to that bourne from which no traveler returns, five have dropped out for various reasons, and the remaining two are still honored members of the association.

"After these fourteen traveling engineers had been heard from, a meeting was held at Chicago, Ill., Nov. 14, 1892 The result of that meeting was the forming of a temporary organization, a chairman, a secretary and treasurer being elected and committees being appointed to draft a constitution and by-laws. During the meeting an invitation was received from Messrs. Sinclair and Hill, of "Railway & Locomotive Engineering" to meet in their offices, at New York city, to perfect a permanent organization. Their kind invitation was accepted and the time for the meeting set for January 9, 1893. The meeting was held at the appointed time, and 53 members were enrolled. The first officers elected were as follows: President, Mr. C. B. Conger; first vice-president, Mr. J. W. Sheldon, Pennsylvania R. R.; second vice president, Mr. R. D. Davis, Illinois Central R. R.; treasurer, Mr. W. E. Miller, Vandalia R. R.; secretary, Mr. W. O. Thompson, Lake Shore & Michigan Southern Ry. Members of the executive committees were Messrs. A. S. Work, J. D. Vantwood, and W. T. Hamer. Thus was the Traveling Engineers' Association, whose motto is "To improve the locomotive engine service of American railroads," and which motto has been rigidly adhered to during its twenty years of existence, started out in the world to do its share towards the wonderful progress that has been made during the past twenty years.

"During the first few years of the association's existence, its condition was rather precarious. At that time the newly created position of traveling engineer was not looked upon as a necessity by the managements of a good many railroads and this opinion was verified in the panic of 1894-5, when, approximately 70 per cent of our membership was set back to running engines and had it not been for the hard painstaking work of a number of our members, the almost immediate popularity of reports and researches of our committees, the loyalty of a few railway supply firms, the association would have died in its infancy; but the organizers of the Association builded better than they knew, as its forming was the means of bringing the hard, many-sided, work of the traveling engineer into conspicuous light, showing our managements the great worth of the hard-working, painstaking men who were acting in the capacity of traveling engineer.

"The benefits to the traveling engineer have also been great. Twenty years ago he was considered nothing more than an engine-tamer and trouble-doctor, but today he is considered an indispensable adjunct to any well-organized locomotive department. During the life of the association,

247 of our members have been selected to fill higher and better positions in railroads and other walks of life, some of them holding the highest positions in the gift of railroads. All the members selected have been hard workers in the association, there having been up to date 153 subjects investigated, discussed and acted upon the recommendations made and over 90 per cent of these recommendations have been adopted either in part or as a whole. We have been recognized by the Master Mechanics' association to the extent of their requesting a representative of our association to be present at each of their annual meetings for the past fifteen years; our annual reports are eagerly sought after by technical schools and societies in this and other countries; we have constantly maintained the good will of the railway newspaper and railway supply world; we have grown from a membership of 53 to 881, and during that time the membership has shown a steady increase; very nearly all our members who have been promoted to higher positions continue their membership and financial support, and today we are in the list with the foremost railway associations in the country, making us believe that the pride we feel in our association is pardonable."

Next in order was the report of the secretary and treasurer, Mr. Thompson presenting the treasurer's report, owing to Mr. Congers illness. The reports showed a total of 882 members and a balance on hand of $3,000.

Benefits Derived From Chemically Treated Water.

The committee report on "Increased Efficiency of Locomotives and Benefits Derived from Chemically Treated Water," was then read, by F. P. Roesch, in the absence of Chairman McArdle.

This report in brief contained replies received to a number of questions sent out by the committee. It was found that in some cases soda ash is being used in the proportion of one pound per thousand gallons. Considerable cost data on the Santa Fe was given and the average cost per thousand gallons treated for 1911 was $0.0324. A number of roads reported the use of anti-foaming compounds. With regard to increase in the mileage of flues and fire-boxes, it was reported that treating plants show an increase of from 78 to 150 per cent and equally good results with the use of anti-scale chemicals. The following is the report of the Santa Fe covering this subject:

"Since the adoption of our water treating system on the Santa Fe Railway, the mileage of our fire-boxes and flues has been doubled and trebled. One of the best examples we have of the benefit of water treatment is the Los Angeles Division. In the latter part of 1905, eight large Pacific type, oil-burning passenger locomotives went into service on that division, and up to December, 1907, each of these locomotives has received a new fire-box, six of them had received three sets of flues, and the other two, two sets; the average for all fire-boxes being 66,064 miles, the lowest being 62,452, and the highest 81,608. The average mileage per set of flues during this period was 25,167. You will understand, that we have mountain grades in that territory, on which helpers are used; the work performed by these engines is heavy fast passenger service. A very large part of the mileage is one per cent grade. I will state that shortly after these engines received new fire-boxes, or in the latter part of 1907 and the beginning of 1908, a number of water treating plants were installed, and three other plants were installed during 1910, consequently some of the locomotives made considerable mileage with second fire-box before the installation of water treating plants was completed. There are no serious defects in any of those boxes yet, and they have up to January of this year given an average service of 168,589 miles, and are still going; the flues have given an average service of over 44,000 miles, an increase in flue mileage of 78½ per cent.

"We on the Santa Fe use treated water to prevent incrustation, and we give credit for the prevention of incrustation and improvement in the performance of our fire-boxes and flues to our system of treating water. We use an anti-foaming treatment to prevent foaming, both in our treated water and in territories where the water is not treated, which does the work very satisfactorily, eliminating all of the troubles due to a foaming boiler, such as wear and tear on valve packing, cylinder packing and machinery, reducing the cost of fuel and lubrication, and enabling us to handle tonnage that it would be impossible for us to handle with a foaming condition.

"In territories where the water is not bad enough to warrant the installation of treating plants, but does give us trouble from foaming, we find that anti-foaming preparations have a favorable effect in preventing incrustation as well. It is but just and fair to a water treatment that counteracts or prevents foaming, to give it credit for adding to the life of the fire-box and flues, on the theory that when it prevents foaming it keeps the water in a more dense condition so that it absorbs more readily the heat that is passing through them, and by so doing prevents their overheating and consequent damage."

During the discussion A. M. Bickel of the Lake Shore & Michigan Southern stated that they had discontinued the use of soda ash in locomotive tenders with superheater engines as it tended to clog the superheater units. In connection with the foaming caused by the soda ash, a number of members had found it advisable to use an anti-foaming compound, which produced very good results. This treatment was said to cost from 1½ to 2 cents per 1,000 gallons of water treated. The matter of surface blow-off cocks was touched upon but with the majority, they had proven unsuitable.

WEDNESDAY, AUGUST 28.

The committee report on Relation of Mechanical Appliances to Fuel Economy was read by the chairman, F. P. Roesch. Following the reading of this report, the convention listened to an address by J. M. Daly, general superintendent of transportation of the Illinois Central, who spoke on tonnage rating. Mr. Daly's address in part was as follows:

Tonnage Rating.

There are two important economical problems yet to solve, one is the Maximum Economical Rating and Loading of Locomotives, and the other is the Reducing of Empty Car Mileage through the Pooling of Equipment. It is just and necessary for our railroad companies to ask us to handle the traffic economically in order that their net revenues may be increased, from the fact that the net earning capacity of the roads has been greatly reduced by legislative action, the cost of every article increased, and unless new economics can be made effective in order to keep pace with these reductions, the only result possible is bankruptcy. When the crusade on reduction of rates and more expensive service obtained real momentum about 1900, the railroad experts got busy on economical methods, notably as follows: First, by the reduction of grades and the elimination of curves; second, by the use of larger capacity cars; and third, by the introduction of larger locomotives. While some properties were fortunate enough to be able to dispose of bonds and stock and raise money to take advantage of these improvements before, as well as since 1900, fully 80 per cent of the roads are not at the present time equipped for economical operation, due almost entirely to the fact that their source of revenue has been curtailed far beyond the limit of good business policy, both as effecting the owners and employees, as well as the public.

Admitting that the roads require economy from the department controlled by the Traveling Engineer, it is well

to carefully analyze the factors that create train resistance and determine what is necessary to be done in order to obtain increased efficiency in the loading of trains. In order to do this, it is necessary to briefly review the methods used in loading trains in the past. Records show that in 1870 the carrying capacity of freight cars was about 24,000 lbs.; today it is 100,000 lbs., an increase of 75 per cent. In 1870 the average weight of a car was 16,000 lbs., or 66 per cent of its capacity, whereas today, a 100,000 lbs. capacity car weighs only 40,000 lbs., or but 40 per cent of its capacity. In 1870 trains were made up on the basis of a given number of cars, and if empty cars were in a train they were rated at two empties equal to one load. Later on this was modified and three empties were considered equal to two loads. This was a reasonably accurate basis due to the uniform capacity and loading of cars moved in tonnage trains, but with the adoption of the large capacity cars, the car basis had to be abandoned and the gross ton basis adopted. About 1895 with the introduction of the large 50-ton capacity coal car, the Hocking Valley R. R. found if impracticable to load engines on the basis of number of cars, as trains with 50-ton capacity cars invariably stalled. This condition necessitated a change, and the gross ton basis was adopted. Immediately on the adoption of the gross ton basis, it was found that an engine rated at 2,100 gross tons when hauling 30-ton capacity cars, gross weight per car 50 tons, had its maximum load with 42 cars or 2,100 tons, whereas the same engine could easily handle 30 cars of 70 tons each, although the gross weight of both trains was the same; hence it then became necessary to equate the tonnage of cars on the basis of the gross weight of each.

About this time Mr. D. F. Crawford, superintendent of motive power of the Pennsylvania R. R., devised a plan to make an arbitrary car allowance to meet the variation in gross weight of cars. This plan is to test engines with a train made up of all light empty cars and another test of the heaviest loaded cars, then divide the difference in the gross tons hauled by the difference in the number of cars hauled, and then to add the result arbitrarily to the actual weight of each car. It was about 1895 that I first began to investigate this problem, and I assure you it was found to be a very interesting as well as a very complicated one to handle. While each of you have met with the same difficulties, it may be well to review some of them at this point: For instance, the placing of heavy loaded cars at head end of train; the making of a different allowance per car according to the grades and curves; the reduction of rating on districts having light rail in spring when the track is soft due to depressions at joints, especially with heavy capacity cars; the resistance due to cold weather freezing the lubrication in the journal boxes; increased wind resistance as the length of the train is increased.

The factor of light rail and poor track surface was brought out clearly in 1900 when I was connected with the Delaware, Lackawanna & Western R. R. The Presidents of the Delaware, Lackawanna & Western and the New York, Ontario & Western roads were discussing the saving to be obtained from the use of large cars and engines. Each thought he had the better engine. I succeeded in getting them to permit us to make a pulling test. We took one of the Lackawanna engines over to the Ontario & Western line, gave it a tank of the same coal the latter engines received, and a train of coal, mostly heavy cars, was made ready and the N. Y., O. & W. engine made the first trip up the Carbondale, Pa., hill; this in order to permit our engineer to get familiar with the grade. The gross tonnage in this train was the same that their engine had demonstrated it could handle without any trouble, but on this test trip it stalled about one-half mile from the top of the mountain. The train was backed down and our engine took it. We stalled about 200 feet below the point their engine stopped. The next day they brought their engine over on our rails and we took the train of heavy cars up Pocono Mountain, 21 miles, in 35 minutes less time than their engine used, both engines having cleared without stalling. Another test was made on our tracks with light loaded cars with the same tonnage both engines hauled the previous day, and engines stalled in less than 3 miles from the starting point. This demonstrated a fact that on the Lackawanna the engines could haul about 20 per cent more tonnage in heavy capacity cars than it could haul in light capacity cars, whereas the reverse was the condition on the Ontario & Western road.

We then made another test on the Ontario & Western with a full tonnage train of cars averaging 55 gross tons, and the engine had no trouble in hauling it over the grade, whereas with 70 gross ton cars it was stalled. This required an investigation and it was a conductor that solved it for us by showing that the heavy cars depressed the rails at joints and made an increased up-hill pull, or as he stated, it made waves in the track at the rail joints due to light rail, poor ballast and surface. This instance is cited merely to show that the building of large capacity cars of itself would increase the expense of transportation, unless additional money was spent for the heavier rail and better roadbed, points which the public does not give proper consideration.

Having considered the necessity for increasing the average train load and the past methods employed, let us now take up the present practice. The American Locomotive Company has published a very elaborate and complete digest on train tonnage, tables being given which show in detail the pounds of tractive power used to move a gross ton over the different grades, also showing clearly that wheel friction is the one important factor to be considered, conceding, of course, that trains will be built up properly on terminals with the heavy loads at the head end. Mr. Cheeney of the Chicago, Milwaukee & St. Paul Ry. has devised the plan of loading engines on the basis of pounds of tractive power used instead of gross tonnage, which is a very accurate basis. The objection to this plan is the amount of clerical time required in busy yards to compute the tonnage. This, however, can be overcome by reducing the pounds of tractive power used per car to the ton unit and by using a properly adjusted computing machine. The last but most important feature in connection with the problem is to see that trains are properly loaded under any plan adopted. My experience leads me to believe that the work of the mechanical engineer, the traveling engineer and other operating officials in determining the resistance per ton of car and other factors previously stated, is the easy part of it. The difficulty is in having the terminal forces build up the trains properly and with the assigned tonnage.

The ideal method to increase the train load is to equate the tonnage of cars, then arrange for the switching department to properly build up the train, and, when ready, have the yard clerk check the track, go to the office, pull the bills, foot the tonnage on the train resistance computer, notify the yard what tonnage to add on or take off, have bills ready for the conductor when he calls and avoid delaying the train in departing, which will save in overtime and fuel and often permit another train to pull in on the track cleared. After the departure of the train, the yard clerk can enter on his daily tonnage report the train number, number of cars hauled, the rating of the engine and equated tons hauled. A copy of this report should be sent to the superintendent or the train master at the close of each day in order that he may investigate at the time the cause of failure to properly load the individual train

instead of investigating the matter 30, 60 or even 90 days later when the terminal is not in position to make an accurate explanation.

The 16-hour service law has materially affected the handling of tonnage and frequently when trains are given their assigned tonnage and it happens to be largely in light capacity cars, it results in dragging over the road and very frequently in the train being tied up on the line on account of this law, thereby creating considerable expense instead of resulting in a saving. This condition can be largely overcome through the equated basis of loading engines, as under that plan the drawbar pull of all trains is equalized so that it is impracticable to have one train exert 40,000 lbs. of tractive power as compared with another train with same tonnage exerting only 32,000 or 34,000 lbs., and by loading the trains with uniform drawbar pull, engines should be able to handle them within the time allowance.

Another factor which has been given considerable thought and on which a large number of tests have been made by some roads is the weather or temperature factor. Tests have been made of the resistance of different weights of cars at 30 degrees above and at different stages from that down to 20 degrees below zero, but personally I do not consider them as of much importance in practical operation for several reasons; first, the temperature may be 20 above zero with a drifting wind which is carrying snow into the cuts, making it much more difficult to operate than if the temperature was zero and calm. Again the temperature at the initial terminal point may be 20 degrees above and calm, whereas 50 miles out in direction the train will move, it is snowing, drifting and down to zero. Again, at certain terminal points where they are fortunate enough to be located on an elevation where they get the benefit of down-grade or momentum in leaving the terminal, an engine at zero temperature can haul 300 or 400 tons more than if the terminal were located in a sag where there is a slight grade leaving the terminal, for the reason that the lubrication congeals when trains stand a few hours in the yard waiting for movement and creates considerable resistance on the journals in starting the train, which continues until such time as the heat of the motion of the journals warm up the oil. Therefore, I feel that the question of loading engines in extreme cold and stormy weather is one which must be left largely to the discretion and good judgment of the men on the ground.

Another factor in connection with the rating of engines which should receive consideration is the making of some slight allowance for trains moving on busy track where there is a large number of superior class trains to keep out of the way of, in order that the train may cross over on double track or take sidings and get out with despatch, instead of being obliged to frequently double out, thereby delaying the passenger trains. In other words, an engine with 40,000 lbs. of tractive power on a one-fourth per cent. grade on one division may be able to handle regularly 3,000 gross tons, whereas on another division where they have heavy traffic, it would be economy to reduce this tonnage to possibly 2,800 tons on account of the number of trains to be met, so that the physical conditions on the individual division or train district must be considered in the rating of the power. An arbitrary set of figures will not apply successfully at all points. In conclusion I wish to say that in my judgment more money is lost in overloading the power than in underloading it, and that the only safe and economical method for obtaining the 100 per cent efficiency is in using the equated basis.

Following the address there was considerable discussion, in which Mr. Daly took part, answering a number of questions pertaining to the subject.

The committee report on Fuel Economy is given herewith.

Relation of Mechanical Appliances to Fuel Economy.

It goes without saying that the only object in burning fuel is to obtain from it the stored-up energy and utilize this energy to produce motion. This being the case, any device or mechanical appliance that will enable us to obtain more energy from a given amount of fuel, or to utilize, by converting into work, a greater part of the energy contained, must be classed as a distinct factor in the fuel problem.

The economy percentage, due to any mechanical device, can be calculated by the increased amount of work obtained from a given quantity of fuel; and as work in this instance means motion, the time element must enter into the problem and the work performed must be considered as in relation to the time elapsing. Therefore, to get the true measure of economy for any mechanical device, the work must be measured not in train or engine miles, but in ton miles per hour.

The relation of any mechanical appliance to fuel economy would, therefore, be in proportion (a) to the decrease in fuel consumption per mile in hauling the same tonnage at the same speed; (b) to the increase in speed, with the same tonnage on an equal amount of fuel per mile; or (c) to the increased tonnage hauled at the same speed on the same consumption of fuel per mile run.

Viewing the proposition from this standpoint, there is no question but that of all mechanical appliances above enumerated the high degree superheater stands pre-eminently at the head. While we do not care to burden or weary you by a repetition of dry statistics, yet in order to prove the assertion just made, some figures (the results of carefully conducted tests) must be shown. The most comprehensive and carefully conducted tests ever carried out in this country, with a view to obtaining definite data bearing on the fuel economy due to the use of superheat, were made by the New York Central, in connection with the Pennsylvania, in 1910 and furnish the most reliable data so far obtained, the fuel results of which are shown in Table 1, in which it is shown that the saving in fuel due to superheat (allowing 2.3 per cent as due to improved circulation, due to arch tubes) was equal to 26 per cent, while the total saving, due to the installation of a brick arch and a superheater, was equal to 33.3 per cent. This test also shows that the application of the brick arch resulted in a net saving in fuel of 7.3 per cent.

Speeds	Sat. Stm. No Arch	Superhtr.	Superhtr. and Brick Arch
12.5	4.67	3.15	2.90
15.0	4.75	3.56	3.25
17.7	4.69	3.40	3.27
Average	4.70	3.37	3.14
Relative Coal Consumption	**100**	**71.7**	**66.7**

Table 1—Dry Coal Per Dynamo: Meter H. P. Hour.

Undoubtedly, next in order, as a mechanical appliance affecting fuel economy, is the brick arch, although the feed water heater runs it a close race and in some instances precedes it. The value of the brick arch as a fuel economizer is due (where arch tubes are used to support it) to increased heating surface due to the tubes, and to the better utilization of the fire-box heating surface already present.

It will be noticed that by a change in fire-box construction and the substitution of a vertical, hollow wall, an even greater fuel economy is effected, and there is no question but that were this type of fire-box used, in connection with a high degree superheater, the greater per cent of the energy now unavoidably lost in our present type of locomotive would be conserved.

The economical value of the brick arch depends upon the

type of holder, the relationship between fire-box heating surface and tube heating surface, the nature of fuel and character of the service, and it is the failure to take into consideration the above essentials that so many widely varying results are obtained, and so many different opinions find credence for and against the value of the arch. Facts are stubborn things, however, and as repeatedly verified tests can be taken as facts, we can safely assert that in the majority of the present-day locomotives the intelligent application of a correct brick arch will result in an economy of fuel ranging from 5 to 15 per cent.

Among other mechanical appliances pertaining toward fuel economy, the feed water heater must not be overlooked. The different types of feed water heaters used in this country have at various times been reported on before this body, and illustrations covering same can be found in past proceedings. Prominent among these are the Buck-Jacobs, as used on the Santa Fe, and the Gaines, used on the Central of Georgia. Personal observations, made by your chairman, as to the efficiency of the former, proved that the temperature of the feed water was increased 75 degrees Fahrenheit. This multiplied by the number of pounds of water heated will give you the saving in heat units and this product divided by the number of heat units obtained in the fire-box from each ton of fuel would represent the fuel saving. No absolute data on this particular subject is available, however, but various estimates have placed the feed water heater, where the temperature is raised 50 degrees Fahrenheit or more, as being equal to from 8 to 12 per cent in fuel economy.

The mechanical stoker.—While the mechanical stoker has a bright future ahead of it, and will unquestionably, when perfected, be applied to such locomotives as consume an amount of fuel beyond physical capacity of the fireman to handle manually, yet as a fuel economizer "per se"—that is, an appliance capable of delivering an increased amount of energy per pound of fuel, as compared to an average fireman—your committee is not prepared to go on record with any definite statements.

Although many tests have indicated that economy in the amount of fuel per ton mile per hour has frequently been obtained with different types of stokers, yet other tests have shown contrary results, thereby still leaving the question of economy in pounds of coal somewhat in doubt, but when calculated on the basis of cost per pound of coal, the balance is in favor of the mechanical stoker, as tests have proven that by means of this appliance a cheaper grade of fuel can be handled successfully. Your committee is prepared to go on record, however, to the effect that on large engines, which tax the ability of the fireman to the utmost, the application of a successful mechanical stoker will result not only in an increased efficiency of the locomotive, but also in a measure of fuel economy after enginemen become sufficiently familiar with it to handle it intelligently.

There are several other mechanical devices, such as mechanically operated fire-doors, grate-shakers, coal-passers, etc., that all have a direct bearing on the fuel problem, but in the absence of any authoritative data bearing on the efficiency of any or all of these appliances in this respect, your committee would prefer to have the relative economies of any of the above brought out in the discussion on the floor.

The handling of trains.—This one question, in the mind of your committee, covers sufficient ground, or has scope enough, to be the subject of a separate and distinct report, especially as the handling of trains has no actual connection with mechanical appliances, as referring to fuel economy. There is no question but that the handling of the train has a material influence on the consumption of fuel, as, for instance, the manner in which the engineer starts his train and handles the engine after starting. Delays en route. Poor meeting points, making it necessary to force the engine to the limit to make one meet and then stop and wait at the next. Poor judgment on the part of conductors, agents, etc., with reference to switching. Make-up of trains, with reference to loads and empties, high and low cars, etc. Leaving box car doors open. Poorly adjusted brakes. Haphazard tonnage ratings. Location of side tracks and water tanks, with relation to grade, etc. Day and night schedules. Quality of engine sand. Distance between coaling and watering stations. Weeds and grass on right of way. Nature of ballast in those sections where heavy frosts and heavy dews prevail; and the hundred and one other items, all connected with handling of trains and having an influence on the coal piles, but covering which nothing definite is available, and if available, would be subject to just as many variables as there are railroads. We, your committee, would therefore suggest that this part of the subject assigned to them be either handled on the floor in the discussion, or be made the subject of a further report at the option of the officers and members.

F. P. Roesch, Chairman.
Dan Daley,
F. R. Scott,
Y. S. Merriman,
D. J. Madden,
G. E. Spangler,
G. M. Carpenter, Committee.

Discussion.

The discussion of this report showed that undoubtedly the superheater was effecting economies, one member going so far as to state that on 20 switch engines in the Detroit district, the brick arch and superheater together had effected a saving of 50 per cent. He also stated that they had had trouble with the smoke inspector but that the smoke had now decreased 50 per cent on these engines. This, however, was largely due to three 2 1-2 inch holes which he stated had been placed in each side of the firebox, with a steam pipe in the center. These switch engines (on the Michigan Central) have 21x28-inch cylinder, carry 180-lb. pressure and run at an average speed of about 6 miles per hour. C. H. Hogan was called on and said that on the New York Central, the superheater had passed far beyond the experimental stage, little trouble having been had since its first installment. W. C. Hurley, of the New York Central, stated that there were 560 superheater engines on his division, that the maintenance was no higher than on saturated steam engines, and that they saved a third in fuel and water. He spoke in favor of a damper, as it effects a saving in fuel. Finally, he stated, "If it never saved a pound of coal or water, give me the superheater engine, for it can deliver the goods." A member stated that their application to Mallets made the engines steam more freely. Representatives of the Locomotive Superheater Co. were given the floor and answered many questions pertaining to the maintenance and operation of superheaters.

There was comparatively little discussion on the subject of stoker. Mr. Street, of the Street stoker, gave a favorable report of the progress of his stoker. He said that the stoker takes coal and that the coal per 1,000 locomotive miles will go up but that the coal per 1,000 ton miles per hour will go down. About the only important thing brought out in the discussion of the brick arch was with respect to the application of a combustion chamber of the Gaines type to four Mallet compound locomotive on the Virginian Railway. Le Grand Parish, of the American Arch Co.,

stated that there were only four or five railroads in the country not using the brick arch at present.

Wednesday afternoon the report on Handling Long Passenger and Freight Trains with Modern Air Brake Equipment was read by W. F. Walsh.

Handling of Long Passenger and Freight Trains With Modern Air Brake Equipment.

The ever-increasing operating requirements of railroads, the advent of long passenger and freight trains and of large locomotives, and the continual public demand for increased speed, have also called for a proportionate improvement in all devices that have to do with the operation of all departments of a railroad, but in no case has the demand for increased efficiency in any one device been so great as in the air brake, and the continual improvements in this device, together with changing of operating conditions, as brought about by the increased length and weight of trains, has also called for a most continuous revision of instructions and methods of handling, and though much has been said and written on the subject of train handling as effected by the air brake, nevertheless it still remains a very live topic, and one upon which there is considerable difference of opinion among those who have made it a study.

With a view of getting as many expressions of opinion as possible, the committee prepared a set of questions bearing on the subject, and had them distributed among the members, but were only successful in receiving four replies.

Train Slack Control.

The control of slack in our passenger and freight trains is the factor in successful handling, and in freight trains this one item is affected by so many variable conditions, that a hard and fast rule for its control is impossible. The slack action is affected more by unequal braking power than by any other single item, and it has been very aptly said by W. V. Turner, in a paper before the Western Railway Club several years ago, that "the operation of the brake is according to fixed laws and conditions over which the engineer of all men has the least control," and still it is upon the engineer that the responsibility rests for the proper handling of trains. With all these variable conditions to be met, his success fundamentally depends upon the use of proper judgment, the ability to grasp and analyze conditions as they arise, and select the general rule of operation of the brake that will cover the situation with the least shock and danger.

To make the handling of long trains successful it will be absolutely necessary to have the co-operation of both our transportation and mechanical departments, the former interested in the make-up of trains and the latter in the maintenance of equipment. When shorter trains were general and comparatively light power was used, the make-up of a train was not given special consideration, nor was it essential that it should be, but when you consider that in the ordinary 100-car train there is over fifty feet of slack, the energy stored in a moving loaded train (especially when concentrated at any one point) is terrific.

With all the improved equipment that has been put into service recently, the success of handling the long train depends chiefly upon how the equipment is operated. By long trains we mean eighty-five cars or over. We would in no case recommend that more than a seven to ten-pound initial reduction be allowed to stop the train, when within fifty to seventy-five feet of the stop another reduction should be made, so that the brake pipe will be exhausting when the train comes to a stop, the latter reduction made to keep the slack bunched and to leave train in a good position for starting. When a stop can be contemplated far enough in advance the throttle should be closed gradually, and the train allowed to drift before an application is made, so as to allow the slack to assume its normal position and bunch slowly, for in the case of our large engines of today, the internal resistance will very readily bunch the slack when the engine is shut off, but in every case where the train consists of loads on the head end and empties on the rear the application should be begun before the engine is shut off, keeping the train stretched as far as possible, otherwise when the brakes take hold on the rear, the slack will run out rapidly, due to the excess braking power concentrated on the rear, with a tendency to part the train.

In all air brake operation the chief factor is the time element, and this governs either when applying or releasing the brakes. The ideal method of controlling slack in long trains would be to cause the serial operation of the brake on each car rapidly enough to make each car do its braking and at the same time equalize the retarding force of each car, but, as a rule, with a long train the stop is completed before the brakes on the rear of the train are effectively set, and while the time element is reduced to a degree by the introduction of the quick service triple, it is still an ever-present factor and one which both the air brake companies are trying to overcome by the use of the electro-pneumatic and load-and-empty brakes; at this time, however, both these brakes are in process of development.

When releasing brakes, the time factor becomes of greater moment so far as the serial operation of the brake is concerned, and where an effort is made to start long heavy trains before the release of the rear brakes the danger of parting is as great as when stopping trains. After coupling up at water or coaling stations or after a full service application has been made, we would recommend that enginemen be instructed to place the brake valve handle in full release position not longer than fifteen seconds and then return it to running position, and that no effort be made to start the train until one minute has elapsed with fifty cars or less, and with trains of over fifty cars two minutes additional be allowed for every twenty-five cars over fifty. For instance, three minutes should be allowed for seventy-five and five minutes for one hundred cars. This is to be independent of the pump capacity, for regardless of the capacity of the pumps for furnishing air, the length of time required to release the brakes depends upon the time required to build the pressure up on the rear of the train, which is entirely controlled by the frictional resistance of the brake pipe. When releasing brakes in all cases, we would recommend the kick-off to release such brakes on the head end as may have re-applied.

General Make-Up and Testing of Trains.

The successful handling of freight trains depends upon the condition of draft rigging, piston travel, brake cylinder and brake pipe leakage, all of which is dependent upon the thoroughness of terminal inspection

Yard test plants should be installed at all terminals, brakes put into serviceable condition, and brake pipe leakage determined before the engine couples to the train. The amount of brake pipe leakage permissable is determined by the length of the train, but it must be remembered that brake pipe leakage is without the control of the engineman, and upon the amount of leakage depends to a great extent his ability to handle the train successfully. The maximum amount of leakage determined upon by a certain large system, who are operating long trains successfully, is as follows: Eight pounds for trains not to exceed twenty-five cars, seven pounds for trains up to fifty cars, six pounds for trains up to seventy-five cars, and five pounds for all trains over seventy-five cars.

The make-up of trains is determined largely by local conditions, such as yard facilities, classification, character of lading and types of cars; however, upon the make-up of the train also depends the ability of the engineman to successfully handle it to avoid break-in-two shocks and shifting of lading. While it is considered impractical to alternate loads and empties, some effort should be made to equalize the braking power of long trains as affected by

loads and empties or light and heavy loads, such as coal and merchandise. This can be done to some extent by distributing the lights and the loads in cuts throughout the train, rather than placing the loads ahead and empties behind, as is the common yard practice. One of the most prolific causes of break-in-two is the improper handling of cars on hump yards and failure to make thorough inspection to determine condition of cars after they have been humped.

Train Handling.

The greatest amount of delay is usually at terminals, caused by not having the train in proper condition to start when the engine couples up, insufficient pump and main reservoir capacity causing a great amount of time to be consumed in charging the train to the required air pressure. All heavy freight engines should be equipped with two pumps, either one of which should be of sufficient capacity to supply the train in case of failure of the other and also to avoid a possible engine failure due to pump failure and should be equipped with main reservoir of not less than 60,000 cubic inches capacity.

In handling freight trains with modern equipment, it must be remembered that we are today in the transition period, the changing over from the "H" to the "K" triple, and most trains consist of a number of both types of triple. The instructions for handling trains remains the same practically as with the older type of equipment; with the "K" triple, however, much more uniform results are obtained, both as to application and release of brakes and recharging of auxiliaries. The quick service feature of the "K" triple reduces the time of application of the brakes and brings about more uniform brake cylinder pressure throughout the train with a lighter reduction of brake pipe pressure, and when applying brakes on trains equipped wholly or in part with "K" triples the initial reduction does not necessarily have to be as heavy as with older type triples to obtain the same brake cylinder pressure. When releasing brakes on trains of "K" triples, or on trains the head end of which consists of cars with "K" triples, the danger of break-in-two is very materially reduced, due to the retarded release feature of this triple, which by retarding the release of the head brakes until the rear brakes have started to release cause a more uniform release of all of the brakes in a train, and at the same time the "K" triple is retarding the recharge of auxiliaries on the head end of the train, causing a more uniform recharge than was possible with the older type of triple.

When handling trains equipped with "K" triples it must be remembered that to get the benefit of retarded release it is necessary to place the brake valve handle in full release position so as to get the assistance of the excess pressure in forcing triples to this position, and the amount of retardation obtained also depends upon the reduction made, the retardation increasing as the reduction in brake pipe pressure, up to equalization. With a five or six-pound brake pipe reduction, the retarding effect is very little, and care should be taken when releasing brakes after a light reduction to prevent rapid running out of slack, as very little retardation on the head end is obtained, due to the low cylinder pressure obtained with a light reduction and the inability to increase the brake pipe pressure sufficiently to move many of the triples to retard release. With short trains or in shifting cars equipped with "K" triples, it may be found of benefit to use running position of the brake valve for releasing, thereby lessening the time required to release brakes by preventing as far as possible the triples moving to retard release.

Comments have often been heard concerning the effects of bunching "K" triples in different portions of a train, but it is the experience of the committee that no ill effects are experienced from any number of "K" triples located in any portion of a train. There is no question that with a number of "K" triples located at the rear of a train, there is a tendency of a more rapid running out of slack, but due to the fact that with a given reduction the cylinder pressure obtained is much lower on the rear of the train than on the head end, the running out of slack is gradual, and we do not believe will bring about any serious results.

There was some fear that the retarded release feature would cause wheel sliding, but this has not been borne out by the experience of the committee or by such information as we have been able to obtain.

Some modern cars have been equipped with thirty and fifty-pound retainers, but your commitee has been unable to obtain any definite information as to results obtained; we, however, feel that they may be of considerable benefit on very heavy grades.

Where engines are equipped with large pumps, there has been some doubt as to the ability to stop long trains by the use of the conductor's valve or where the break-in-two occurs near the rear, and several cases are known where the train proceeded for a considerable distance after breaking in two without any appreciable fall in pressure shown by the gage on the engine, and while this is possible where the train has not been charged up, several tests which were conducted on a 100-car train show that by opening the conductor's valve all brakes could be set, the feed valve would release the first ten or fifteen brakes and keep them released, the remainder of the brakes would remain applied, these tests being conducted with the brake valve handle in running position. Where the train is properly charged, a break-in-two would stop the train; therefore enginemen should be impressed with the fact that when handling long trains with engines of large pump capacity they should not attempt to start until all auxiliaries have had time to charge, and it requires from fourteen to twenty minutes to charge the one hundredth car from zero to seventy pounds. We do not mean to imply that it is necessary to stand still that length of time, but sufficient time should elapse after coupling up when the engine has been detached for long periods to give auxiliaries time to charge up sufficiently, so in case of a break-in-two the brakes would set. It has been the experience of your committee that where trains break in two, proceed and leave the rear, usually occurs at water tanks or where engine has been detached from the train for a length of time and an effort is made to start the train without waiting for time to recharge. The conductor should be instructed that when necessary to stop the train from the rear the conductor's valve should be opened wide, without the usual effort to make a service application.

The instructions for handling of long trains with modern equipment are much the same as previous instructions issued for the handling of trains with the older equipment; the most important fact to call to the attention of our enginemen is the necessity for using them both in starting and stopping. Care must be used when handling the engine equipment, where the engine is equipped with either "ET" or "LT" brakes, as these brakes are positive, and it is as dangerous to create a high braking power at the head end as it is at the rear; in fact, on double track it is more dangerous to run the slack in rapidly with the engine brake than to run it out, such as empties would do on the rear, due to the liability to buckle trains. With either "ET" or "LT" equipment the locomotive brake is absolutely within control of the engineman, either to increase or decrease cylinder pressure as his judgment may dictate, as it is due to the flexibility of operation of these equipments, especially when releasing brakes on moving trains, that a number of our break-in-twos have been prevented.

A few general instructions should be given to enginemen, which, together with the use of good judgment, will practically eliminate break-in-twos.

When using steam, independent or automatic brake, care should be used not to run the slack in or out too rapidly; the heavier the engine and the longer the train the more care and time should be used.

No accurate stops should be attempted; where engine has to be spotted, such as water tanks and coaling stations, it should be detached from the train.

A light initial reduction should be made and that allowed to stop the train, except that when within fifty to seventy-five feet of the stop another reduction should be made so that the brake pipe will be exhausting when the stop is completed, this to leave the train in a favorable position to start.

Straight air should not be used to make stops or to handle trains except when releasing brakes, and then only to assist "K" triples in preventing slack from running out.

When beginning application, the speed of the train should be taken into consideration; it must be remembered that the retarding force of any given cylinder pressure increases as the speed decreases.

When handling long trains on grades, such application should be made as necessary to control speed of train, care being taken to prevent over-heating of tires.

On long grades where upward of seventy-five cars are handled and where the character of the grade will permit, it will be found of advantage to turn up about seventy-five per cent of retainers on head end of train. This will have a tendency to keep slack from running in and out each time application and release are made, and this is especially so where light loads or empties are being handled on rear.

With trains of over seventy-five cars, the brakes should not be released after speed had reduced below fifteen miles per hour.

When backing long trains, where possible to do so, trains should be allowed to drift to a stop, otherwise steam should be used with the locomotive brake released to keep slack from running out too rapidly.

Handling Passenger Trains.

With the introduction of heavy steel passenger equipment came the introduction of the double "PM" equipment, the "LN" and "J," a little later the "PC" and now the electro-pneumatic brake is being pushed for passenger service and in quite general use on subway trains in New York City.

The double "PM" equipment consists of two separate sets of brakes on each car, a brake for each truck, and has proven more or less unsatisfactory, due to the increase in volume to be taken care of and the attendant liability of stuck brakes unless the greatest amount of care is used. In ordinary passenger train handling with double "PM" equipment it is absolutely necessary that very close attention be given to the condition of triple valves, especially as to the tightness of the packing ring, otherwise unless heavy reductions are continually made trouble will be experienced with brake sticking. In our instructions to enginemen we would recommend that they make no reductions of less than fifteen pounds, the reduction being split, the initial reduction to be six pounds, so as to gradually bunch the slack in the train, that to be followed with a nine or ten-pound reduction before releasing and the brake valve handle to be kept in full release position with over eight cars at least five seconds. Unless enginemen will follow these instructions there will be more or less trouble experienced with the "PM" equipment, due to burned-up brake beams or slid flat wheels, the explanation being that the heavy load remaining on the slide valves of each triple valve where the pressure is reduced to but a few pounds below standard, coupled with the slow rise in brake pipe pressure requires that triple valve piston packing rings be a good fit to insure release. It must be understood that if the speed of a train is slow the heavy reduction, if made while moving, will have about the same effect as quick action. A light reduction should be made to stop the train, and after being stopped the brake pipe pressure should be further reduced, so as to insure release.

With either the "LN," "J" or "PC" equipments the best results are obtained by splitting up the reductions, for in our long passenger trains the slack action can be made mighty uncomfortable for passengers, without considering even the danger. We would recommend that in each case the preliminary reduction be from six to eight pounds, and after a short interval the necessary reductions be made to stop the train; it must be remembered, however, that the brakes with these equipments are positive and severe, and care should be taken at slow speeds to prevent wheel sliding. With the "PC" equipment it is necessary to make a seven or eight-pound reduction of brake pipe pressure before the brake applies, the high differential being used so that slight variations in brake pipe pressure, such as would be caused by a sluggish feed valve, will not cause an undesired application.

On account of the large volume of air required for heavy passenger trains, and the various devices on engines operated by air, it is imperative that passenger engines be equipped with two pumps, and should not have a main reservoir capacity of less than 50,000 cubic inches.

As the "PC" and electro-pneumatic brakes are practically new, there remains considerable to be learned, and there are no doubt some members present who, through their experience with these equipments, will be able to bring out a number of points of interest and importance to all the members.

W. F. Walsh, Chairman,
E. F. Wentworth,
W. V. Turner,
C. W. Wheeler,
H. A. English,
H. A. Flynn, Committee.

This report brought out considerable discussion, which not only occupied the remainder of the day but ran through Thursday morning.

THURSDAY, AUG. 29.

H. T. Bentley, principal assistant superintendent of motive power of the Chicago & North Western, gave what he was pleased to refer to as a talk. He paid a compliment to the work of Mr. Hayes, on the Erie, and emphasized the fact that department heads should insist on road foremen attending conventions and mixing with the old timers. A little encouragement, he said, is one of the finest things to get results. One of the important points which he brought out was with respect to the rough handling of trains. The public is getting very critical with regard to this, and the road foreman could do much to alleviate it. Other points brought out were with respect to the safety habit and with respect to smoke abatement. With regard to the latter, he said that the engineers and firemen were responsible for the emission of smoke and that they must co-operate. Smoke abatement was a question of education. Mr. Bentley mentioned the too frequent oiling which some engines receive, asked co-operation with the round-house foreman and in conclusion urged that the Traveling Engineers' Association and the American Railway Master Mechanics' Association co-operate with a view of allowing the former to take up some of the details which the latter did not have time to take care of.

In resuming the air brake discussion L. D. Gillette asked Mr. Turner, of the Westinghouse Air Brake Co., what he would recommend as to the proper time in handling brakes to avoid shock. In reply Mr. Turner said that it was entirely in the hands of the engineer, and that the only way to avoid shock on long trains is by electro-pneumatic brakes. The elimination of shock he said was purely a

question of time—the time necessary to dissipate the energy of the train—and that the solution was to give the engineer plenty of time to make his stops. Mr. Gillett then asked if he could recommend any improvement in the conductor's brake valve, to which Mr. Turner replied that he considered this a difficult problem. The conductor's valve should be used only in an extreme emergency, and that at other times the conductor should signal the engineer. Mr. Turner thought it an advantage to have two such valves on each car. The discussion emphasized the fact that engine men have been driven into quick stops and that they have fallen into the error of saving every second. The railroad is not run for the air brake, and the possible saving of time is a negligible quantity. Among other things touched upon during the discussions were the handling of heavy trains, the authority of the engineer over the fireman, air brake instruction by the traveling engineer, and smoothness of operation.

Engineers' Reports and Inspection of Locomotives at Terminals.

The text of this report is very short, and ordinarily the duties in this respect could be defined in a very few words, but on account of the varying conditions on different railroads we find it difficult to outline any fixed rule that would be generally applicable.

Many changes have taken place since the iron horse of today was a colt. In those days the enginemen were paid by the month and assisted in making repairs when the engines were in the shop. Later on they were paid by the mile, and, where practicable, inspectors were provided and enginemen were relieved to a certain extent of the responsibility of inspection and reporting the necessary work, on account of their opportunity for doing so being more limited.

As time passed, the responsibility of the enginemen along this line, without any apparent reason, appears to be still further lessened, and at the present time we feel that we have gone too far in the wrong direction.

During this time other material changes have taken place, viz.: Engines are larger and more complicated, trains longer and heavier, number of trains are greatly increased, necessity for high-speed trains, and the sixteen-hour law is to be complied with. These conditions make engine failures more expensive than ever before, and to reduce them to a minimum it is very important that a careful terminal inspection be made and the necessary work done before the engines are again put into service. This, in addition to the Safety Appliance and the Federal Boiler Inspection Laws, should emphasize the importance of a careful terminal inspection.

The committee is of the opinion that no money expended by the railroad company will return a larger dividend as that paid the enginemen for the short time it requires to make a careful terminal inspection and report.

The committee is further of the opinion that there should be no one more capable of making this inspection than the enginemen, and we therefore feel that the strongest position should be taken, and advocate a careful and general inspection by the enginemen, and court their full support in taking care of the expensive and heavy power we are now handling.

Enginemen should make close observation of the operation of the engine while on the road, in order to determine defects that cannot be so well located while the engine is at rest.

On arrival at the terminal he should begin at the front of the engine and inspect the condition of the parts as follows:

Condition of the smoke-box front, to see that the door is properly secured and that no loose nuts exist about the front. The condition of the cellars and bolts as far as he can see, all parts of the valve gear, guide bolts, frames, springs and rigging, ash pan slides, tender trucks, condition of couplers and operating mechanism, condition of truck and driving wheel flanges, note temperature of bearings, examine rods for loose bushings and nuts, cross heads, driver and tender brake shoes and rigging.

Enginemen should report whether or not the engine throws fire dangerously, and any defects, such as valves out, cylinder packing or valves blowing, engine steaming badly, injectors not working, pop valves out of order, flues or any other part of the fire-box leaking, grates out of order, any defect in the air brake equipment, rods or boxes pounding —and such other defects as would usually come under his observation while operating the engine: If there should be any pounds or blows that he has been unable to locate while on the road, a careful terminal test should be made and the trouble located.

Enginemen should be conversant with the Safety Appliance and Federal Inspection Laws, and report any defects that would constitute a violation of same.

"Shotgun" reports, or such reports as "engine pounding or blowing or steaming badly," should be discouraged. With careful checking of the work reports and the assistance of the Roundhouse Foremen, we find, will greatly assist in the education of new men.

In recent years the introduction of large engines has made it important to have all concerned give them their best attention in order to give efficient service—and unless we have the benefit of a careful inspection and the observation and co-operation of the enginemen, we will work under a disadvantage, which means dollars and cents to the railroad company.

We should bear in mind the importance of having men in charge of engines who are well posted in their construction and competent to handle them in the best possible manner. And in order to encourage them to reach this point of efficiency, we should be as exacting as circumstances will permit, in requiring the men to be well qualified before promoting them, and after they are promoted require them to give intelligent and careful attention to the engines in their charge and hold them responsible for failure to report any defects they have had an opportunity to find by using reasonable care.

H. F. Henson, Chairman,
G. C. Jones,
J. C. Petty,
W. H. Dellert,
J. B. Hurley,
R. H. Fish,
M. J. Keating,
G. S. Tillman, Committee.

In the discussion, several members mentioned the pooling of engines as causing an undefined responsibility for inspection. Pooling of engines is was conceded, however, has come to stay, on account of the saving effected in the investment, and the opinion was general that the engineer should be fully competent to make a complete inspection.

FRIDAY, AUG. 30.

The first paper taken up at this session was the report on Getting Engine Men Interested in the Economical Use of Fuel and Lubricants. After some discussion of this report the convention was favored with an address by B. A. Worthington, president of the Chicago & Alton, who had a host of stories and witty remarks at his command which put his audience in very good humor. In conclusion, he asked the traveling engineer to help others to think and to do what he could to overcome doctrines which tend to set up a class hatred. Decay begins in discord, said Mr. Worthington, and the traveling engineer had the opportun-

ity to do much in keeping healthy relations between man and man.

The Economical Use of Fuel and Lubricants.

Fuel economy in some of its phases has been given some attention almost annually since the origin of this Association; with the last few years, however, it has been more than ever of vital interest. One very good reason for this is the increased cost of fuel.

In the fuel producing states of the Central Southwest within the past six years the unit cost of fuel has increased 25 per cent.

Any discussion of fuel economy almost invariably brings out some reference to the engineer and fireman. It is therefore probable that nearly all of the items contained in this paper will have been brought up in previous meetings.

The motto of this Association is to improve the locomotive engine service of American railroads. In our opinion, nothing would fulfill this aim more than a high order of education and interest in the use of fuel and lubricants, and we respectfully urge that the report of this committee be amplified by a liberal discussion of this subject.

In the preparation of this paper, a list of questions was submitted to the membership. Sixteen replies were received and contained some very helpful suggestions, the substance of which was to emphasize the importance of a systematic plan of education for the firemen, the hearty co-operation of not only all officials, but all others whose duties may in any way affect the use of fuel and lubricants, and the close personal contact between the Traveling Engineer and his engineers and firemen that is absolutely necessary in order to obtain the best results from the locomotive, as well as the importance of reports that will show the actual performance of each engine or crew, also information showing just how much better than average performance it is possible to do when the locomotive is in proper condition and is skilfully handled.

Some interesting information was furnished by ten Traveling Engineers who had been closely following fuel economy for a little more than a year, having performance sheets made under their direct supervision, on quite a large railroad, where the locomotives are for the most part in pooled service, and the general situation, such as various types of coaling stations, different kinds of fuel, fluctuations in business, which calls for a rather sudden increase or decrease in the number of crews employed, as well as changes in terminal mechanical forces, would perhaps qualify it to be classed as representative of a considerable per cent of mileage of American railroads.

We are told that fuel used for locomotives in the United States alone, in 1911, amounted to about 132,000,000 tons, at a cost of approximately $240,000,000.00. At least 10 per cent of this did not come under the control of the engineers and firemen, although, as a rule, it is charged to their performance, and it is not uncertain for enginemen to feel that a great deal of the fuel charged to their performance is reaching the engine tank that can be saved (although it costs nearly as much to save it as it is worth), it should be done, if for no other purpose than to show the enginemen that every reasonable effort is being made to give them credit for what they are able to do. No more fuel should be used in making engines ready for a trip than is necessary, and if extra fuel is used, by reason of lack of terminal facilities or engines ordered before they are needed, it should be charged to Terminal Consumption.

In some instances the matter of fuel economy has been left almost entirely to the Traveling Engineer, although he may have very little in the way of records to work from and may not have an intimate knowledge of how the data was obtained for whatever records were furnished.

In a recent valuable treatise on fuel economy the author says: "The reason men working along these lines have not obtained better results is due to the overwhelming odds they have had to work against." Generally speaking, the Master Mechanic is busy looking after the maintenance of equipment, the Assistant Superintendent in the movement of traffic and keeping down the cost of overtime. The Traveling Engineer, also, usually has a multiplicity of duties, but if he is to obtain the best results in interesting the enginemen in the use of fuel and lubricants, his duties should not be so numerous that he cannot map out and follow a rather definite plan of work; otherwise these economies are apt to become of a secondary importance. His work should be heartily endorsed by his superior officers and supported by a system of records as accurate as can possibly be maintained, and he should be familiar with the methods of compiling records, in order that he can explain them whenever necessary and detect errors that may occur.

In this connection, we wish to emphasize the necessity of a correct disbursement of fuel to each engine and the importance of the engineer familiarizing himself with the amount of fuel used during the trip. We have found it a good plan, where chutes are equipped with scales or means for accurately measuring the coal, to occasionally meet the engines on their arrival at coaling station and after the engineer has given his ticket for the amount he thinks necessary to fill the tank, advise him the exact amount of coal delivered. By doing this the enginemen will very soon become familiar with what a given space in the tank will hold. Under present-day practices enginemen are not apt to be as familiar with this feature as in former times, when coal was delivered from pocket chutes or from buckets or buggies.

One railroad has adopted the plan of posting bulletins at the terminals showing the tons of coal unloaded during the month, as per billed weights at the various coaling stations, and the percentage of this amount as represented by the engineer's estimate on their fuel tickets, also the fuel foreman's estimate. The result of this is that the engineers' estimates are now getting very close to the actual amount of coal received, whereas, formerly, they did not represent more than 60 per cent of the amount received.

Generally speaking, the more a man knows about what he is doing, the more interested he will become. One thing that has made enginemen lose interest is the fact that there is not enough attention given to getting accurate charges to the engines. This feature too often is in the hands of the person who makes the coal report, without special reference to the amount actually delivered to the engines.

The Traveling Engineer should be familiar with the various grades of coal. If it can be done, it is a good plan to visit the mines with the fuel agent or other purchasing officer, and, if possible, accompanied by the Division Master Mechanic from the locality in which the fuel will be used. They will both learn a great deal about the fuel end of the business and be able to discuss it intelligently with all concerned.

It is a good plan to checkweigh coal occasionally for their own information, to know how it is holding out with the billed weights. The Traveling Engineer should also use his efforts to have the coal properly prepared before being placed on the engine tank.

One of the best ways to interest the enginemen in what can be accomplished in the use of fuel and secure their cooperation is to make test trips in various classes of service similar to those shown herein, which are records of actual trips made, although some of the data originally shown has been omitted to save space. The scoops of coal are counted with a tally counter, unless coal can be accurately measured otherwise. In making such tests, frequently the water used

is noted, the distance run between water tank stops and the amount of lubricants used, or any other data that may be considered advisable.

Fuel Performance.

Through freight, engine 1283, Engineer Wells, Fireman Doran, Springfield to Newburg, distance 119 miles.

Gross ton miles handled 130,401
Total time an road .....7 hours, 40 min.
Delay .....2 hours, 30 min.
Coal used .....7 tons
Coal per 1,000 ton miles.....108 pounds

No coal taken at Sleeper. Water taken only one place on division. Per cent rating, 101.

Through passenger, engine 1111, train 106, August 3d, 1911, Fort Scott—Kansas City.

Total running time .....2 hours, 45 min.
Total delay ..... 8 min.
Number of stops 4
Cars in train 8
Total car miles 800
Oil consumed .....708 gallons
Gallons per car mile 885

The injector never worked at more than 50 per cent maximum capacity.

Through passenger, engine 1051, train No. 4, May 6th, 1912, Springfield to Newburg, Engineer Hailey, Fireman Shockley.

Total running time .....3 hours, 13 min.
Total delay .....10 min.
Total car miles 840
Amount of water used .....8,000 gallons
Scoops of coal used 401
Average weight per scoop .....16 pounds
Amount of coal consumed .....6,416 pounds
Pounds per car mile ..... 7.63 pounds

Engine held at Newbury from 5:20 p. m. to 2:00 a. m., and made ready on 46 shovels of coal. 53 square feet grate area.

Considerable publicity is given these records. They are frequently shown on the enginemen's bulletin book or copies are sent to the employes' magazine. Where the performance is especially good, the superintendent of the division or other officer commends the enginemen, a copy of the letter and performance being attached to their personal record file. We should give the men all the credit that is due them. They have to take the blame whether they like it or not whenever the performance is not good.

Another method in use on certain divisions is to send out a mimeograph form at the end of the month to each engineer, showing car miles or gross ton miles handled by him during the month, the total amount of fuel used and pounds of coal or gallons of fuel oil per car mile, per thousand gross ton miles and the average of all engines in similiar service, with such comment as the Traveling Engineer may see fit to make.

In submitting the question, as outlined by the subject, to a number of engineers and firemen, their reply almost invariably is: "Give us regular engines; do the work on them, and let us know what we are doing in the use of fuel and lubricants." These items are not under the control of the Traveling Engineer, but are mentioned to show the arguments he has to combat. On a great many roads, certain conditions will not permit of assigning regular engines, and it is, no doubt, possible to maintain engines in pooled service in as good condition as in regular service, but it is rarely ever done, and it is therefore difficult to excite the same interest in pooled as in regular service.

Without doubt the condition of the engine has more bearing than any other one item, and the Traveling Engineer should use his best efforts to have the engines maintained in the best possible condition. They should be made to steam with as large an exhaust nozzle as consistent, it being understood that all other draft arrangements are properly adjusted before contracting the nozzle, but by all means they should steam freely. It is almost impossible to get a fireman interested in fuel economy on an engine that does not steam well. A periodical inspection should be made of draft appliances and a correct record of all measurements and sizes of nozzles maintained, in order that engines of the same class will have uniform exhaust openings, which will permit the fireman to carry the same depth fire in each engine of the same class.

Cab arrangements should be made convenient and comfortable, injectors of proper size and so maintained that they can be skillfully operated, valves not only square but well balanced, so that engine can be worked in short cut-off when necessary and still lubricate properly, a throttle that will remain in any desired position, proper distance between fire-door and coal gate, fire-doors proper height from deck, deck guards if necessary, so that firemen will not have to be continually raking coal in to prevent it wasting from gangway. Grates, flues, steam pipes and all draft appliances should be kept in first-class condition and ash-pan provided with ample openings for air admission.

An electric flash light torch is a valuable aid to the Traveling Engineer, if he wishes to make an occasional personal inspection of draft appliances without opening the front end door, or noting condition of flues and grates. This is especially useful where fire-tube superheaters are in use, due to the fact that ordinary torch test is insufficient, as the return bends are some distance from the flue-sheet and cannot be seen with the illumination furnished from an oil torch and also from the fact that they may be almost entirely clogged and still have sufficient draft to draw in the flame.

Engineers' work reports should be closely followed up, for if certain men are careless in making their reports, others will become discouraged, feeling that their efforts in properly locating and reporting defects are not appreciated, and while all engineers realize the importance of it, some of them are apt to become a little careless in reporting worn cylinder packing, leaky steam chest, worn choke plugs, pockets in oil pipes or valve motion in such condition that it will cause valves to be worked in 8 to 10-inch cut-off when 5 to 6-inch cut-off will do the work.

Many men in the ordinary performance of their work do not realize they are using a little more fuel and supplies than is necessary, not because they are indifferent but because their attention has not been called to the fact that it is possible to do better. In riding with the engine crews the Traveling Engineer should encourage the efforts of the engineer and fireman in handling the train with as little fuel as possible consistent with maintenance of schedule. In doing this, if circumstances will permit, explanation can be made to the enginemen what a relatively small saving by each crew per trip will mean in decreased operating expense on the entire Division for one month. Encourage them to make similar tests when you are not with them. A very good illustration is to have them experiment to see just what kind of a run can be made by working the injector at minimum capacity or nearly so. Show them how to figure ton miles and car miles and ask them to come to you if the work reported on the engines is not promptly done or to advise you in regard to other items that need attention, in order to save fuel, and show them you appreciate it by having such matters looked after. Ask the engineer to handle the engine so as to assist the fireman in every way in keeping a clean fire. Nothing will cause the fireman to lose heart more than to have a fire spoiled by engine slipping leaving a terminal after he has been very careful in getting it properly prepared.

The most successful engineer will tell you that he attributes much of his success to knowing the condition of the fire at all times, as well as the physical condition of

the fireman and in having the fireman confident in his ability to keep the engine hot, encouraging him to make a study of keeping a clean fire at all times, rather than in trying to keep the engine at the poping point every minute, regardless of what may happen to the fire in doing so and causing engine to steam hard on the last part of the road with resultant waste of fuel.

Close attention should be given to know that engines leave terminal with clean fires. The education of fire builders and engine watchmen is as necessary as that of the new firemen.

It is a good plan to keep a record of the conditions of fires brought into terminals and the time required for cleaning them. Firemen who succeed in bringing in a good fire for a certain period—say thirty days, can be commended for same, while the fireman that do not bring in good fires should have their attention called to it and be asked for an explanation.

In the selection of men who are to become firemen, the Traveling Engineer should play an important part. He should see that the right material is selected, a system in vogue for the men to make student trips not only with the best firemen, but men who are known to be of a good disposition; have a talk with him, if possible, before he goes to work and let him have an idea of the amount of fuel he will be required to handle and the importance of economy in the use of same to avoid extra labor to himself and needless expense to his employer. Encourage his confidence and help him to select proper reading matter on combustion and the locomotive.

Progressive examinations are in use on a number of roads, and this, in the opinion of your committee, is one of the very best means of interesting the firemen. This should, we believe, be rigidly followed up on every railroad.

General meetings for enginemen and all other employes whose duties may in any way affect the use of fuel are productive of good results. The attendance of the officials has a very helpful influence. The meetings should be arranged for in advance and subjects announced and the men asked to give their opinions. Many suggestions will be offered, and, if they are practical, they should be tried out.

On one railroad, mechanical clubs have recently been formed; officers are elected and committees appointed from among the engineers and firemen, the Traveling Engineer usually being the president or a member of one of the committees. Subjects are arranged for in advance, a question box is provided and questions or suggestions are deposited therein and thrashed out at the meetings. If the Traveling Engineer or some one else is to specialize on a subject and cannot be present, the subejct may be continued to a subsequent meeting and a general discussion had on something else, such as a certain number of questions from the progressive examination. Charts and blue-prints are provided, showing proper and improper methods of firing, on drafting, also on lubrication and other matters of interest.

In the use of lubricants, a first-class terminal organization is necessary for the systematic care of cellars. We believe each engineer should be furnished with his own hand oilers and supply cans, so that he will be credited with his savings. The oil should be charged to engineers and not to engines—the schedule sufficiently liberal to prevent, as much as possible, issuing extra oil.

On the road quoted, where the Traveling Engineers are supervising the fuel performance sheets, soon after records were started, a number of enginemen advanced the idea that a more liberal supply of lubricants would save fuel, and an experiment was tried on one division. Although it was considered the schedule was quite liberal at that time, each engineer was given an extra supply of cylinder oil to start with and all concerned were advised that it was not the intention to save lubricants at the expense of fuel. The fuel and oil performance were both closely checked for a month, at the end of which time it was decided that there would be nothing gained by a change in the oil schedule previously in effect.

We believe it is in some cases practical to ask engineers to make tests of the amount of oil required in the various classes of service and to have cylinder heads or valve covers removed at the end of trips or test, for their information or such other examination made as may be considered necessary.

While it is possible to run pooled engines with the same amount of oil as regular engines, generally speaking, we believe engines with regular crews will be better lubricated on the same amount of oil than pooled engines. With regular engines, the engineer knows just how the cups are feeding and how all bearings are running. In pooled service, he will not know this or whether lubricator was entirely fed out when engine came in and valves and cylinders dry. On this account he will probably feed the lubricator a little too fast to start with than on a regular engine. Also, not knowing how engine will steam or do its work, he is more apt to fill the boiler a little too full when starting out than with a regular engine. Unless he drains the lubricator, he will not get the oil saved on easy trips. Pooled engines usually do not get over the road as well as regular engines. Again, if oil goes out of sight in the gauge glass, the engineer will probably adjust the feed to run to the end of the trip, regardless of the effect on fuel consumption.

No test figures are at hand to show the effect of insufficient lubrication. The statement has been made before this Association that not less than 12 to 15 per cent in tractive effort is lost when lubrication is insufficient.

We believe it is a good plan to let the men know about what the fuel and lubricants cost and what the company, with their help, is trying to accomplish. What will awaken interest will maintain it, and this can only be accomplished by continually keeping after it. New ideas will continually present themselves and the enginemen will contribute many good suggestions.

We should encourage rather than criticise and endeavor to master the work thoroughly in hand ourselves, and as Mr. Quayle said to us last year: "Be desperately in earnest." We should be ready to reason out clearly from our own viewpoint any question that may arise. Make a close study of each individual engineman, so as to approach him from the most favorable angle and in such a way that will not cause any embarrassment.

No one man has the monopoly of all the best brains or methods, but the Traveling Engineer observes the work of all and he should not miss an opportunity, where circumstances will permit, to correct (kindly, of course, but surely) all improper methods and equip himself to teach the men who have not acquired it, the art, as practiced by many engineers and firemen on all railroads, of handling fuel and lubricants scientifically.

Robt. Collett, Chairman.
J. F. Meredith,
D. L. Eubank,
L. Redford,
W. H. Donohue,
J. S. Lemley,
C. F. Schraag, Committee.

Discussion.

J. A. Cooper:—The road foreman should first show his interest and then the engineer cannot help but take an interest.

E. Salley:—Mr. Hayes said that $10,000 was saved in one month on the Erie. This was accomplished solely by education and close supervision. A few years ago we distributed an instruction book which was a great help. We then gave

the men a set of questions at the end of the first year and at the end of the second year.

J. B. Wimmer:—To get economy it is most essential to get personally acquainted with the engineer and fireman. We use oil burners and would say that more money can be wasted with oil than with coal. We keep a record of the number of inches of oil in the tank at the beginning and end of the day. We have a flange oiler on most of our locomotives.

J. W. Hardy:—We must have personal contact to keep the men interested and it is very helpful to show the men facts by actual example. For instance we weighed out 1 pound of coal and 7¼ pounds of water, in order to show the amount of water one pound of coal would evaporate. We also showed them that this would pull the engine over the division 90 feet one way and 80 feet the other. Engine men are put in touch with the cost of fuel—so much per day, per hour and per second—on my road, and we tell them where it comes from and of the difficulties of obtaining suitable coal. We have certain fuels for certain districts. The road foreman would be able to accomplish better results if he did not have so many duties.

Mr. Preston asked if the saving made on the Erie was an actual saving or an accounting saving and was informed that it was an actual saving.

W. E. Simon urged the necessity of rules for taking care of fires on down grades, as much energy was lost during such periods.

D. J. Madden:—It is necessary to look over the condition of the power and the square up valve motions, fix leaking pop valve and whistle valves and make the engine tight.

Martin Whelan:—The engineer should be absolutely in charge. If an engineman says he don't want a fireman, we don't put him on. On account of the indiscriminate use of oil, we issued instructions not to take the oil can down when looking over engines. Another thing I would urge—never lose your temper and if you do lose it, don't let anyone know it.

Mr. Kenyon:—A road foreman should have jurisdiction over not more than 30 engine crews.

Mr. Collett in closing, said that we must educate the man higher up to the needs and opportunities of the Traveling Engineer.

At the conclusion, F. C. Thayer presented his report as the representative of the Traveling Engineers' Association, at the Atlantic City convention of the American Railway Master Mechanics' Association, after which the paper on "Advantages and Disadvantages of Lead" was presented. Its conclusions are as follows:

Advantages.

1. It gives what it termed preadmission of steam, or steam is admitted into the cylinder before the piston has reached the end of the stroke, thus furnishing a cushion for the piston and reciprocating parts.

2. It gives a wider opening of the steam ports when steam is admitted, insuring as near as possible full boiler pressure at the beginning of the stroke and also gives an increased port opening after the crank pin has passed the center, by keeping the port open longer than it would be were it without lead.

3. Lead permits of an earlier cut-off in the stroke and consequently a longer expansion of the steam. An increase of one-eighth of an inch in lead would reduce the cut-off a total of one inch on one side of the locomotive; but it must be remembered that an increase of lead hastens every other operation of the valve.

4. During the exhaust of a locomotive, the walls of the cylinder and the piston have had a chance to cool to a certain extent and the pre-admission of steam or lead insures the reheating of these parts at an earlier moment than would be the case without lead.

Disadvantages.

1. When the crank pin is at or near the dead center, any pressure against the piston will have no effect to turn the wheel, and if the engine has lead it will actually tend to work against the engine on the other side of the locomotive, which is at its mid-stroke and therefore doing all the work at that instant of moving the locomotive forward, especially is this true for locomotives used in slow service with hard pulls.

This may be overcome to a certain degree by setting the valve blind in back gear, in order to help the forward gear. By doing this, the lead is made almost constant for full and mid-gear.

2. We all know that when running at full speed, if we shut off the throttle and drift, we notice no ill effects from pounding; in fact, the engine sometimes runs better due to the lack of pounding which occurred when the engine was working steam. This would seem to indicate that when in high speeds the cushion of steam provided by lead is not at all necessary to arrest the motion of the reciprocating parts.

Mr. Darby of The Pilliod Co. then spoke concerning possible breakdown of the Baker-Pilliod valve gear and suggested remedies. He also answered a number of questions asked him by different members.

Next in order was the report of the committee on subjects for 1913, the following subjects being recommended for committee reports:

Uniform Instruction to Enginemen on the Handling of Superheater Locomotives.

The Credit Due to the Operating Department for the Efficient Handling of Trains.

The Care of Locomotive Brake Equipment at Terminals.

Also papers on:

Advantages to be Obtained With the Brick Arch in Locomotive Service.

What Can We Do to Eliminate the Black Smoke Evil in Locomotives Using Bituminous Coal?

Scientific Train Loading.

The election of officers resulted as follows: President, W. H. Corbett, M. M., Michigan Central, Michigan City, Ind.; 1st Vice-President, F. B. Roesch, M. M., El Paso & South Western, Douglas, Ariz.; 2nd Vice-President, Robt. Collett, Supt. Loco. Fuel Ser., St. L. & S. F., Springfield, Mo.; 3rd Vice-President, J. C. Petty, Trav. Eng., Nashville, C. & St. L., Nashville, Tenn.; Secretary, W. O. Thompson, M. C. B., N. Y. C. & H. R., Buffalo, N. Y.; Treasurer, C. B. Conger, Grand Rapids, Mich.

The following were elected members of the executive committee to succeed Messrs. Collett, Richardson, McAndrews and Petty: W C. Hayes, H F Henson, Martin Whalen and J. W. Hardy; the latter for one year and the first three for two years.

Chicago was chosen as the next place of meeting, with New York second choice and St Louis third. After listening to a number of impromptu talks, including a notably good one by Mr. Gillett, the convention adjourned.

The Norfolk & Western Ry., it is stated, will spend $150,000 for the construction of repair shops, roundhouse, machine shops, office and storehouse at Norfolk, Va.

The Southern Pacific Co., it is said, will spend about $200,000 in erecting a roundhouse and shops at Phoenix, Ariz. Six miles north of Phoenix the road will build a water refining plant.

The Cleveland, Cincinnati, Chicago & St. Louis Ry., it is reported, plans the erection of a $20,000 roundhouse at Cairo, Ill., work on which is to begin immediately.

RAILWAY EQUIPMENT MANUFACTURERS' ASSOCIATION.

The Railway Equipment Manufacturers' Association, at its annual meeting in Chicago, August 29, in connection with the Traveling Engineers' Association, elected new officers as follows: President, W. L. Allison, Franklin Railway Supply Co.; secretary, F. H. Clark, Watson-Stillman Co.; treasurer, B. J. Neeley, Jenkins Bros. The new members of the executive committee are: R. H. Weatherly, The Pilliod Co.; F. W. Furry, Ohio Injector Co.; and John Platt, Hunt-Spiller Mfg. Corporation.

The past treasurer of the association reported the financial affairs in excellent condition, the exhibit in connection with the Traveling Engineers' convention at the Sherman House, Chicago, was the best in the history of the organization.

The following are among the members of the association who exhibited at the convention:

American Arch Company, New York. Represented by Le Grand Parish and F. G. Boomer.

American Locomotive Company, New York. Represented by C. A. Delaney, W. J. Becker and T. Kennedy.

American Steel Foundries, Chicago. Represented by J. D. Taylor, F. A. Lorenz, Jr., and W. G. Wallace.

Barco Brass & Joint Company, Chicago. Represented by F. N. Bard.

S. F. Bowser & Co., Inc., of Fort Wayne, Ind. Represented by W. T. Simpson.

Chicago Car Heating Company, Chicago. Represented by G. E. Bucker, E. E. Smith, Geo. T. Cook and E. A. Schreber.

Chicago Pneumatic Tool Company, Chicago. Represented by John Campbell.

Commercial Acetylene Company, New York. Represented by H. G. Doran.

Crane Company, Chicago. Represented by F. D. Fenn and G. S. Turner.

Dearborn Drug & Chemical Works, Chicago. Represented by R. F. Carr, J. D. Purcell, W. S. Reid, J. F. Roddy, C. S. Murray, A. W. Cooley, F. C. Fosdick, T. H. Price, I. H. Case, A. W. Crouch and Thos. Wooley.

Detroit Lubricator Co., Detroit, Mich. Represented by A. D. Homard.

Dickerson Manufacturing Company, Clinton, Ill. Represented by F. Hinckley.

Dressel Railway Lamp Works, Boston, Mass. Represented by J. D. Hidgkins.

Emery Pneumatic Lubricator Company, St. Louis, Mo. Represented by N. J. McAloney.

Flannery Bolt Company, Pittsburgh, Pa. Represented by T. R. Davis.

Franklin Railway Supply Company, Franklin, Pa. Represented by W. L. Allison, Jos. Sinkler and W. H. Coyle.

Galena Signal Oil Company, Franklin, Pa. Represented by W. E. Brumble, J. A. Graham, D. Eubank, W. J. Vance, J. S. Brown, W. E. Maher, G. E. McVickers, John Ferguson, J. Linneham, B. H. Stack, W. H. Taylor, M. M. Meham and C. Royal.

Garlock Packing Company, Palmyra, N. Y. Represented by John P. Landreth.

H. G. Hammett, Troy, N. Y. Represented by E. C. Sawyer.

Hobart-Allfree Company, Chicago. Represented by W. H. England, E. H. Allfree and W. H. Belmaine.

Hunt-Spiller Manufacturing Corporation, Boston, Mass. Represented by J. G. Platt, V. W. Elliott and J. M. Moore.

Jacobs-Shupert U. S. Firebox Company, New York. Represented by C. B. Moore, G. H. Pearsall, M. C. Beymer, H. W. Jacobs, A. Whiteford and E. Wilhelm.

Jenkins Bros., New York. Represented by B. J. Neeley.

H. W. Johns-Mansville Company, New York. Represented by J. C. Younglove, P. C. Jacobs and D. L. Jennings.

Keystone Lubricating Company, Philadelphia, Pa. Represented by W. E. Harrington and J. Mowery.

The Leslie Company, Lyndhurst, N. J. Represented by J. J. Cizek and S. Ingalls Leslie.

Liberty Manufacturing Company, Pittsburgh, Pa. Represented by H. A. Pastre and S. A. Bockius.

Locomotive Improvement Company, Clinton, Ia. Represented by Geo. L. Barker.

Locomotive Superheater Company, New York. Represented by G. L. Bourne, R. R. Porterfield, S. Hoffman, H. J. Bell, C. D. Hilferty, R. M. Ostermann, P. S. Robinson, G. E. Ryder, E. E. Spengler and W. W. Tawse.

Mason Regulator Company, Boston, Mass. Represented by F. A. Morrison.

Manning, Maxwell & Moore, Inc., New York. Represented by F. P. Smith, C. L. Brown and J. H. Bush.

McCord & Co., Chicago. Represented by W. J. Schlacks and H. S. Whitehair.

Nathan Manufacturing Company, St. Louis, Mo. Represented by J. S. Seeley, George Royal and A. S. Work.

National Boiler Washer Company, Chicago. Represented by William White and H. A. Varney.

National Graphite Lubricator Company, Scranton, Pa. Represented by L. S. Waters.

National Tube Co., Pittsburgh, Pa. Represented by W. F. Jones, A. M. Hobart, Francis Worcester, L. R. Phillips and W. W. Orrison.

New York Air Brake Company, New York. Represented by B. Pratt, George Kleifgers, Wm. Owen and L. W. Sawyer.

Ohio Injector Company, Chicago. Represented by F. W. Furry and F. W. Edwards.

Okadee Company, Chicago. Represented by A. G. Hollingshead, W. Dangels and H. L. Winslow.

Parsons Engineering Company, Wilmington, Del. Represented by W. H. Savery.

Permanent Manufacturers' Exhibit of Railway Supplies, Chicago. Represented by John Gill and W. N. Mitchell.

Pilliod Company, Swanton, Ohio. Represented by R. H. Weatherly, F. E. Pilliod, F. A. Wilcoxen and R. F. Darby.

Pneumatic Jack Company, Louisville, Ky. Represented by G. R. Maltby.

Pyle-National Electric Headlight Company, Chicago. Represented by H. A. Rayley, E. B. Barris, R. L. Hilker, F. Pyle and J. W. Cleary.

Rabok Manufacturing Company, St. Louis, Mo. Represented by T. A. Wray.

Railway List Company, Chicago. Represented by L. F. Wilson, O. W. Middleton, W. R. Toppan, F. W. Miller.

Ryan Galloway Company, Chicago. Represented by L. W. Galloway and Ed. Ryan.

Sargent Company, Chicago. Represented by Geo. H. Sargent and F. G. Dunbar.

Wm. Sellers & Co., Philadelphia, Pa. Represented by W. W. Storm.

Simmons-Boardman Publishing Company, New York. Represented by L. B. Sherman, J. N. Reynolds, F. H. Thompson, E. A. Averill and Kenneth G. Cloud.

Angus Sinclair Company, New York. Represented by Allen G. Wood and Angus Sinclair.

Storrs-Mica Company, Owego, N. Y. Represented by C. P. Storrs and Tom Brown.

U. S. Metallic Packing Company, Philadelphia, Pa. Represented by M. Brewster and Chas. Way.

Watson-Stillman Company, New York. Represented by F. H. Clark.

Westinghouse Air Brake Company, Pittsburgh, Pa. Represented by E. Hartenstein, L. Wilcox and L. B. Hutchins.

The Southern Ry. has awarded a contract for a combination depot and freight room at Warrenville, S. C., to I. C. Abbott, of Brandy, Va.

The Tidewater & Western R. R. is said to have awarded a contract to W. D. Steinbach & Sons, Lewistown, Pa., calling for the construction of a passenger and freight depot at Cumberland, Va.

Mikado Type Locomotives, Chicago Great Western

Since 1909 the Baldwin Locomotive Works has built for the Chicago Great Western forty consolidation type locomotives which are designated as class G-3. These engines weigh 216,000 pounds, with 187,000 pounds on driving wheels, and develop a tractive force of 46,500 pounds. The total heating surface is 3,685 square feet. In securing additional power this year, advantage has been taken of the increased capacity afforded by the Mikado type, and the road has recently received from the Baldwin Locomotive Works ten locomotives of this type, which are known as class L-1. These locomotives are equipped with Schmidt superheaters, and counting each square foot of superheating surface as equal to 1½ square feet of water evaporating surface, the total equivalent heating surface of the L-1 engines is 5,525 square feet. Compared with the G-3 locomotives, the new engines show the following:

Increase in total weight	32 per cent.
Increase in weight on drivers	18 per cent.
Increase in tractive force	17 per cent.
Increase in grate area	41 per cent.
Increase in total heating surface	50 per cent.

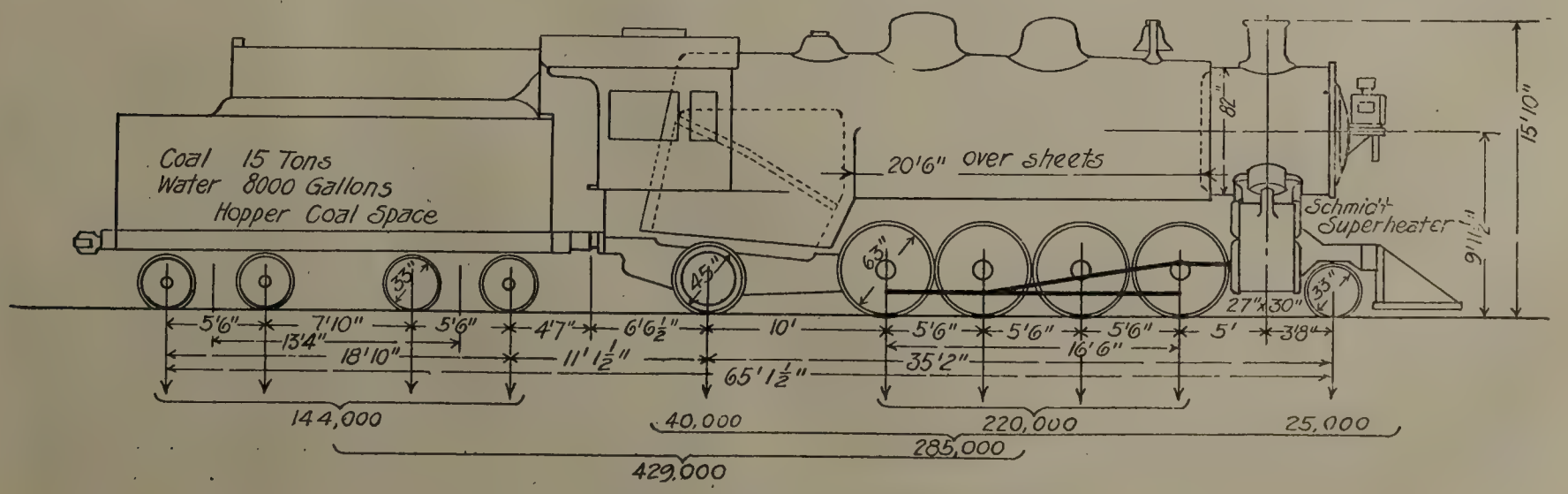
The above figures, however, do not fully measure the greater relative steaming capacity of the new engines. In the case of the Mikado type locomotives, the per cent increase of firebox volume is slightly more than that of grate area. The depth of the throat, measured from the under side of the barrel to the bottom of the mud ring, has been increased from 15½ to 29 inches; while the depth of the firebox, at the forward end, has been increased from 74 to 89¼ inches. This provides ample room, in the Mikado type locomotives, for a brick arch with its supporting water tubes. Such arches are not used in the consolidation type locomotives. A deep furnace and properly designed arch effect important economies when burning high volatile coals.

In the Mikado type locomotives provision is made for discharging a supply of heated air into the furnace at the top of the arch. Five combustion tubes are placed in the throat, and these communicate with ducts which are formed in the arch bricks. By means of a suitable piping arrangement, jets of steam can be discharged into these ducts, and the steam, mingled with air, enters the furnace near the top and aids the combustion of the gases. In a similar manner, provision is made for discharging four jets of steam and air into the furnace on each side, immediately above the bed of fuel.

The boiler has a straight top, with sloping firebox roof sheet. The firebox is radially stayed, and 477 flexible bolts are placed in the breakage zones, in the throat, sides and back. The dome is of pressed steel, in one piece, measuring 33 inches in diameter and 20 inches in height. The longitudinal seams in the barrel rings are placed on the top center line. They are welded at the ends, and have diamond welt strips inside.

The superheater is composed of 36 elements, and steam is conveyed to the cylinders through outside pipes. The steam distribution is controlled by 15-inch piston valves, which are of the built up type, and are set with a lead of ¼ inch. Walschaerts motion is used, and the gears are controlled by the Ragonnet power reverse mechanism. This device has been successfully applied by the Baldwin Locomotive Works to a large number of non-articulated as well as Mallet locomotives. It

New Mikado Type Locomotive, Chicago Great Western R. R.



Design Diagram of Chicago Great Western Mikados

greatly reduces the labor of handling the engine, saves valuable space in the cab, and makes it possible to easily change the cut-off while running, so that the locomotive can be operated in the most economical manner.

The main frames are of vanadium cast steel, 4½ inches wide, and spaced 43 inches between centers. The front rails are double, of forged iron, and the top rail extends back over the leading driving pedestals. The upper frame rails are strongly braced between adjacent pairs of drivers, and the front pedestal legs, at the main and rear drivers, are braced by deep steel castings which extend the full depth of the pedestals. The rear frame sections are spliced to the main frames under the front end of the fire-box, and the expansion plate which carries the mud ring is supported at this point on a strong transverse frame brace. The rear truck is of the Hodges type and is fitted with a horizontal controlling spring. The equalization system divides between the second and third pair of driving wheels.

The tender has a steel channel frame and water bottom tank. The trucks are of the arch bar type, with "Standard" rolled steel wheels. Similar wheels are used in the front engine truck.

Experience with superheater locomotives indicates that these engines, when handling full tonnage, will actually burn less fuel than the class G-3 consolidation locomotives consume when hauling their full rating. The principal dimensions of the new locomotives are presented in the following table:

Gauge	4 ft. 8½ in.
Cylinders	27 in. x 30 in.
Valves	15 in. piston
BOILER.	
Type	Straight
Material	Steel
Diameter	82 in.
Thickness of sheets	¾ in.
Working pressure	185 lbs.
Fuel	Soft coal
Staying	Radical
FIRE BOX.	
Material	Steel
Length	120⅝ in.
Width	84 in.
Depth, front	89¼ in.
Depth, back	75¾ in.
Thickness of sheets, sides	⅜ in.
Thickness of sheets, back	⅜ in.
Thickness of sheets, crown	⅜ in.
Thickness of sheets, tube	½ in.
WATER SPACE.	
Front	5 in.
Sides	5 in.
Back	5 in.

TUBES.

	Iron.	Steel.
Material		
Thickness		
	No. 9 W.G.	No. 11 W.G.
Number	36	262
Diameter	5⅜ in.	2 in.
Length	20 ft. 6 in.	

FEED-WATER HEATER TUBES.	
Number	
Diameter	
Length	
HEATING SURFACE.	
Fire box	241 sq. ft.
Combustion chamber	sq. ft.
Tubes	3,833 sq. ft.
Firebrick tubes	31 sq. ft.
Total	4,105 sq. ft.
Grate area	70 sq. ft.
DRIVING WHEELS.	
Diameter, outside	63 in.
Diameter, center	56 in.
Journals, main	11 in. x 12 in.
Journals, others	9 in. x 12 in.
ENGINE TRUCK WHEELS.	
Diameter, front	33 in.
Journals	6 in. x 10 in.
Diameter, back	42¼ in.
Journals	8 in. x 14 in.
TRAILING WHEELS.	
Diameter	
Journals	
WHEEL BASE.	
Driving	16 ft. 6 in.
Rigid	16 ft. 6 in.
Total engine	35 ft. 2 in.
Total engine and tender	65 ft. 1½ in.
WEIGHT.	
On driving wheels	217,900 lbs.
On truck, front	25,100 lbs.
On truck, back	40,100 lbs.
On trailing wheels	
Total engine	283,100 lbs.
Total engine and tender, about	435,000 lbs.
TENDER.	
Wheels, number	8
Wheels, diam.	33 in.
Journals	5½x10 in.
Tank capacity	8,000 gals.
Fuel, capacity	14 tons
Service	Freight

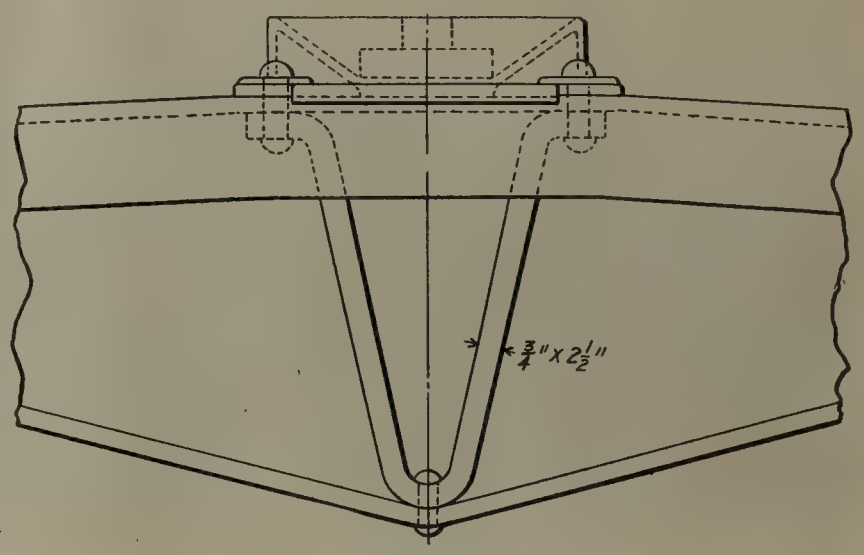
Engine equipped with Schmidt superheater.
Superheating surface, 880 sq. ft.

BOLSTER REPAIRS.

By W. F. Cremean, General Car Foreman, Hocking Valley Ry.

I am attaching hereto a sketch showing method by which we replace the struts on Simplex truck bolsters.

Many of our cars are equipped with Simplex bolsters, most failures of which we find due to broken struts, and the application, to the old bolster, of the same kind of strut as removed, requires the removal of the end casting and straightening out the lap of the truss member where it engages the channel, before the strut can be placed in position. We found that it was nearly impossible to make a satisfactory job in this manner without the proper facilities and have been using the method shown in the sketch for more than a year, finding it the cheaper and better way of making repairs. It requires two pieces of bar iron (we use ¾x2½ in.) formed to suit the bolster, which are secured by center plate rivets and rivets in the truss member.



Replacing Broken Bolster Strut.

The first operation, of course, is to remove the rivets through the center plate and broken strut, with a view of disengaging the latter. Two holes are next drilled in the bottom of the truss member for ⅝-in. rivets. The new struts are then placed in position and secured by replacing the center plate rivets, extending them through the struts as before, and, in order to keep them in position, the bottoms of the struts are riveted to the truss member. We have found it advisable to use a jack to spread the top and bottom members of the bolster before applying new struts and the struts should be made slightly longer than the old ones to insure the bolster having the proper shape after being placed under the load. This makes a very substantial job and total cost of material and labor for making repairs by this method is only about $1.12, which is considerably less than the labor cost for applying new struts such as are standard to the bolster.

The method, I believe, is original and may be of benefit to other railroads using this style of bolster.

The Maxton, Alma & Southbound contemplates building into Rowland, N. C., a distance of 15 miles from Alma, A. J. Steed, treasurer, Alma, N. C.

Surveys are under way for a line from Amarillo, Tex., to Texahoma, Okla., for the Texas, Kansas & Oklahoma. Warren Wickerson, Texahoma, Okla, is the engineer.

It is reported that the Minneapolis, St. Paul & Sault Ste. Marie is planning to build 40 miles of road west from Plaza, N. D., and lay rails to the east bank of the Missouri River this fall.

The Piedmont & Northern has let contracts for work between Greenville, S. C., and Spartanburg, to the Parker Brooks Construction Co., Macon, Ga., Willard Boggs, Spartanburg, and to J. Thomas Bennett, Charlotte, N. C.

Proviso Terminal, C. & N. W. Ry.

A new terminal is being put in operation by the Chicago & North-Western Ry. at Proviso, 13 miles west of Chicago, which is the culmination of a number of improvements in this territory. The North-Western has three main lines running out of Chicago, the Milwaukee division running north, the Wisconsin division running northwest and the Galena division running west. About a year ago the Desplaines Valley Ry. was completed, connecting these divisions and forming an outer belt line for the transference of freight between the divisions, thus avoiding the passage of freight through the congested Chicago district. In connection with this plan, large freight yards were built at Proviso, just west of Melrose Park, where the Desplaines cut-off strikes the Galena or western division. A new engine terminal was therefore necessitated at this point in order to handle traffic quickly and expediously.

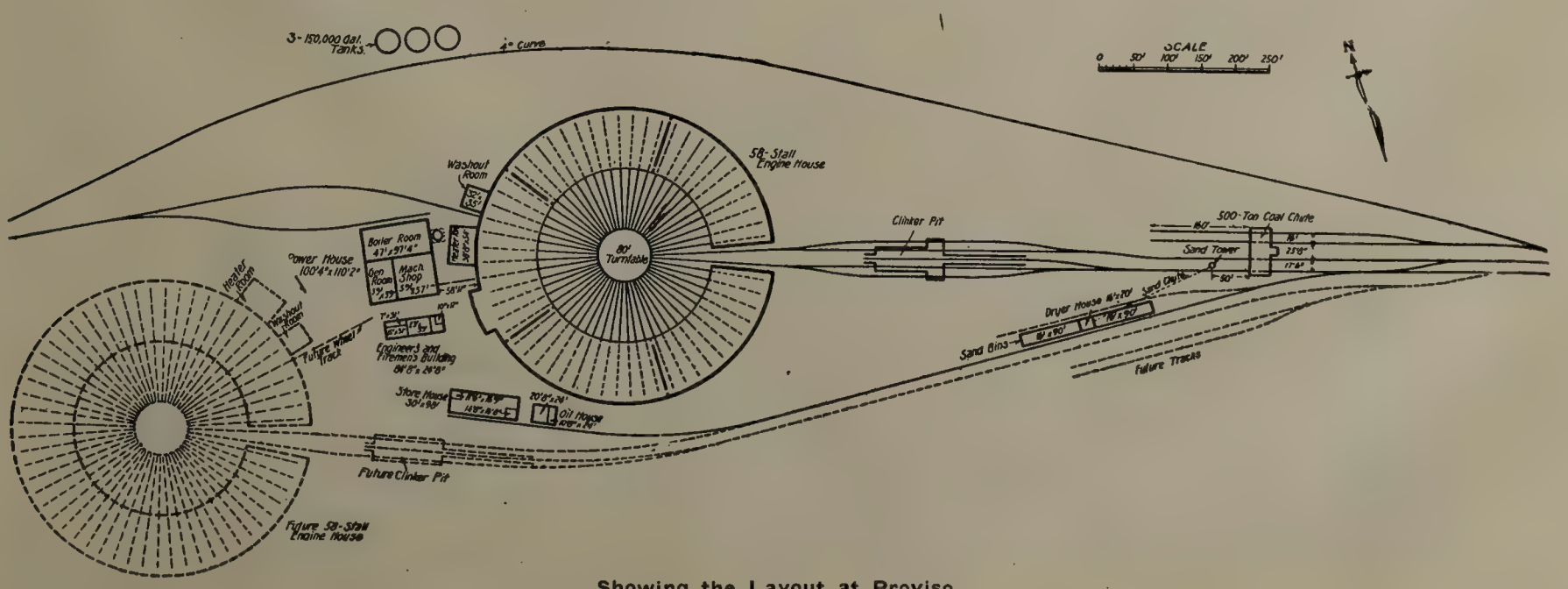
View of Proviso Terminal, C. & N. W. Ry.

Interior of Proviso Roundhouse.

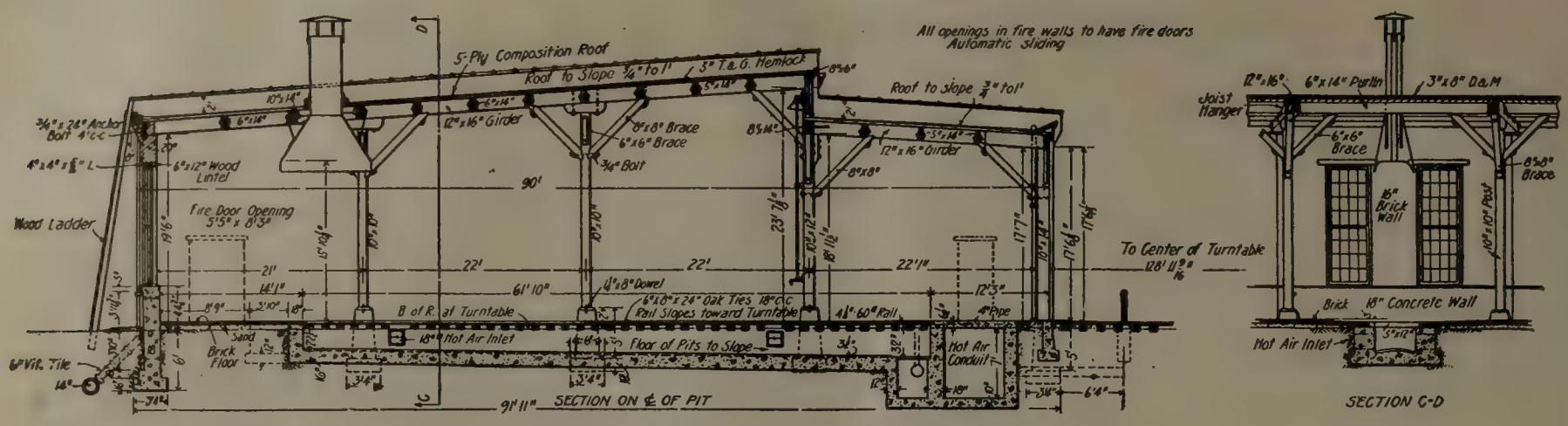
The terminal consists of a 58 stall roundhouse, engineers' rest room, coaling station, oil house, machine shop and power house, sand house and storehouse. The roundhouse is a standard No. 1 North-Western roundhouse, with brick walls, concrete foundation, wooden columns and girders and composition tar and gravel roof. There are four fire walls dividing the house into five sections, the doors in these walls being hung with the Allith Manufacturing Co.'s automatic door closing device. The paving is of hand burned vitrified brick laid on 6 inches of sand. Three 50-ton hydraulic jacks are provided for the drop pits and between every other pit is a short work bench and vise. Aside from a number of drop lights, all lighting in the roundhouse is done by lights placed on the wall at a height of about 8 feet. Each of these lights is supplied with a reflector and lense, one light being placed opposite each end of each pit. This system of lighting has been used on all roundhouses recently constructed by the North-Western and has been found very satisfactory. It makes the lights readily accessible and obviates lighting the upper part of the roundhouse. "Transite" smoke jacks supplied by the H. W. Johns-Manville Co. are used.

Two annexes are provided to the roundhouse, the boiler washout room being located opposite stall 33 and the heater room opposite stalls 29, 30 and 31. The washout system was installed by the National Boiler Washing Co. of Chicago. A fan system of heating was installed by the Green Fuel Co. Two hot air conduits 78 in. x 84 in. lead from the heater and fan room to the roundhouse proper. These are of concrete and are provided with steel sleeves and steel dampers for all outlets leading into engine pits. The clere story windows are operated in fours by Payson geared sash operators. Sanitary drinking fountains are provided at convenient places.

The method of placing and handling the concrete during construction is of interest. A construction track was laid across the middle of the engine house location running to one side of the turntable site. On this track two switches were put in, connecting to a track which was extended entirely around the outside of the outer wall stakes. This track arrangement is shown in the sketch. The excavated material from the turntable pit was loaded into cars on the center track, which was gradually lined over as the excavation was completed. The excavation from the engine pits and for foundations for the inside engine



Showing the Layout at Proviso.

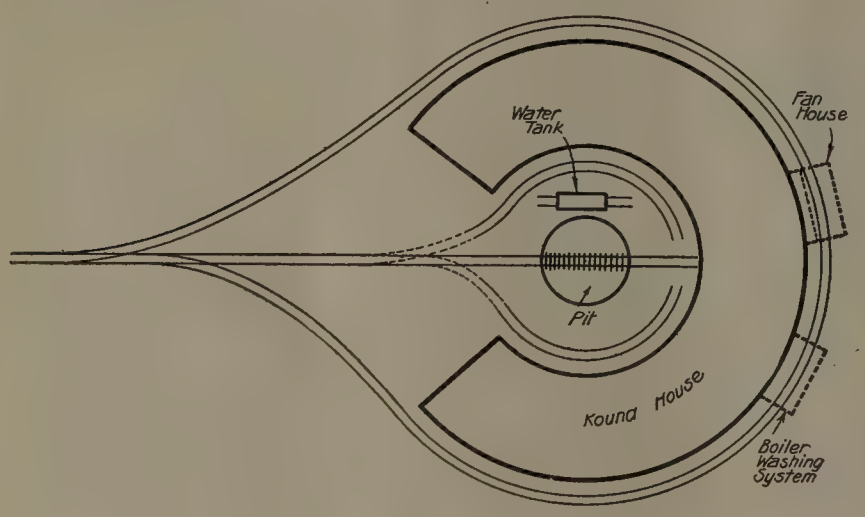


Construction of Proviso Roundhouse.

house wall was also loaded on cars on this track. On the opposite side of the turntable a short track was also layed for loading excavated material. Connection was made to this short spur by cutting the entering track back of the turntable pit, lining it over and connecting up. The end of the short track was carefully located so that a good connection was made without using switch rails. After the turntable pit was excavated, a crib was built across the center and a short section of track laid, which also could be connected to the entering track.

All of these tracks were used later to spot the mixer on, when putting in concrete. To furnish water to the mixer a large wooden water tank was spurred out on a short piece of track between the turntable pit and the inner engine house wall.

This track was cribbed up as high as it was thought safe in order to give a gravity flow of water as far as possible. It was found necessary to use a pump around the outside of the engine house. A small Emerson pump was used for this purpose.



Track Layout Used During Construction at Proviso.

Work on the fan house and boiler washout was left until the last, so the outside track could be kept in. When work was started on these buildings, it was necessary to tear up that part of the track on the locations of the buildings.

The walls of the engine house are built on chords. The concrete for these was poured in three sections. The footing was put in two sections, and the short wall above was placed later. Forms were built for one-fourth of the roundhouse, and these were moved around as the work progressed, saving not only a good deal of lumber, but a good deal of framing work. The lumber used was 2-inch matched and dressed on one side. Contractors frequently use 1-inch lumber, and make the concrete comparatively dry, but in this work wet concrete was used, necessitating heavier forms, because of the fact that the wetter concrete requires less tamping, and results in better concrete is placed by unskilled laborers.

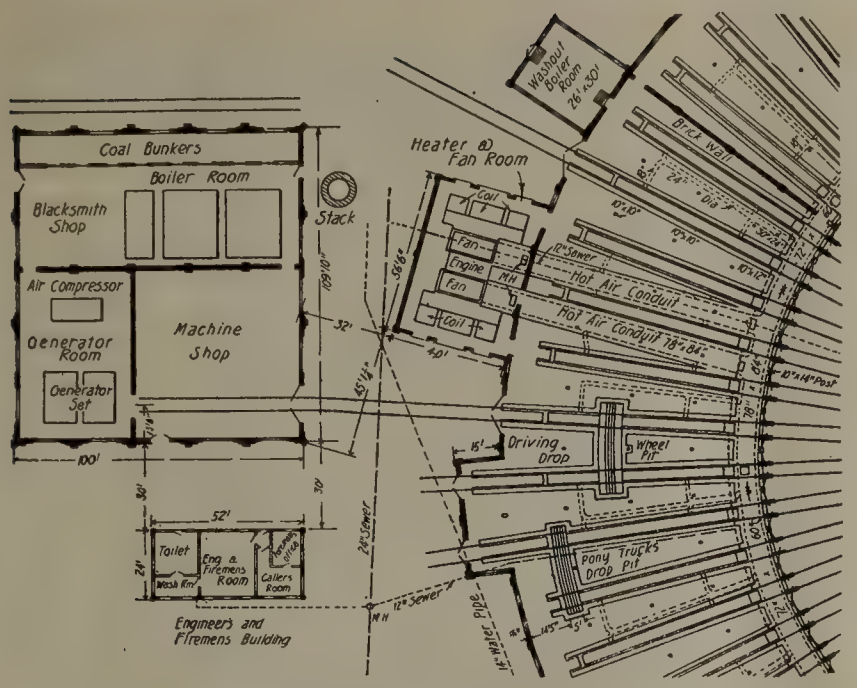
The center pier for the turntable rests on a square concrete pier, 10x10 feet. The foundation for this, and for all the buildings in fact, rest on a hard blue clay. No piles were used under the turntable foundation. The short ties for the turntable track were nailed to place in the forms, and the concrete was put in around them, which was much more satisfactory than if holes were left and the blocks grouted in place. Between the ties the concrete sloped down, following the general slope of the pit bottom towards the center. The summit at the center drains into the sewer system underlying the freight yards.

The turntable pit walls were built in a true circle. To obtain the required arc, 2-inch by 12-inch planks were used. The arc was layed on these planks by a template, and was sawed into correct shape at the shops. The two parts of a plank were placed opposite each other in the forms, at the correct distance. The form timbers were vertical and nailed to the curved sides of the planks. The forms were wired together, little bracing being required.

The turntable is of 80-foot span, having a hand lock and is equipped with a 12 H. P. electric tractor built by the Detroit Hoist & Machine Co.

Ash Pit Showing Forms Still on Concrete Rail Supports.

The power house and machine shop is located opposite track number 28, in a concrete and brick building 100x100 feet. This building contains the boiler room, 47x97 feet, the generator room, 59x39 feet, and the machine shop, 59x57 feet. In the boiler room are five 150-H. P. boilers supplying steam to two Russell engines direct connected to General Electric generators. These are respectively 150 and 200 K. W. Besides the switch board and generator, the generator room contains a Norwalk air compresser having a capacity of 1,000 cubic feet of air per minute. The partition between the generator room and machine shop is of hollow tiling, 6x8x12 inches, and the floors in both rooms are of creosoted wood blocks. The coal bunkers which are arranged along the exterior wall of the boiler room are equipped with Kinnear steel rolling doors. Ventilation is provided for by six 24-inch galvanized iron ventilators and Fenestra window sash is used throughout. Tungsten clusters are used for lighting. The power house stack has an inside diameter of 9 feet 4 inches, and an outside diameter



Plan of Machine Shop and Roundhouse.

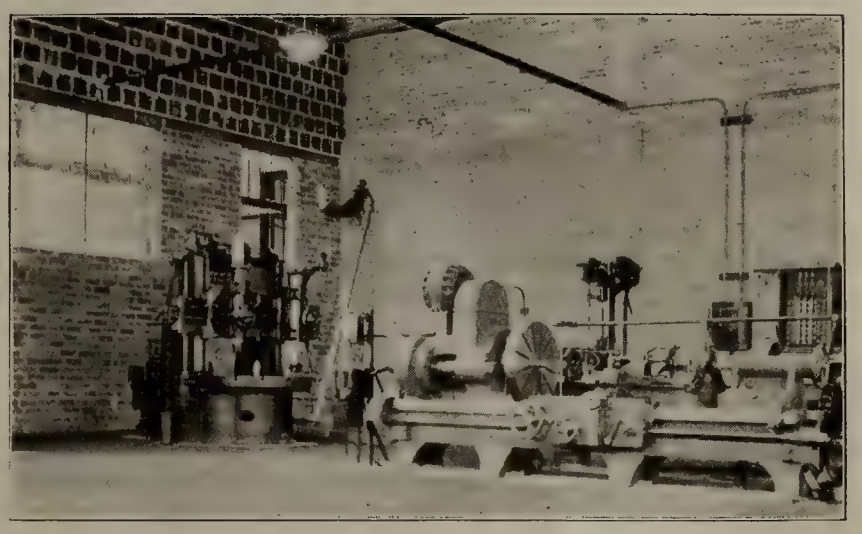
of 12 feet 8 inches. The following machine tools have been installed in the machine shop.

New Doty Shear.
Standard Bolt Cutter.
Two Niles-Bement-Pond Boring Mills.
Niles-Bement-Pond Lathe.
Niles-Bement-Pond Planer.
Niles-Bement-Pond Shaper.
Ransom Double Grinder.
Niles-Bement-Pond Drill Press.
W. F. & John Barnes Drill.
Niles-Bement-Pond Steam Hammer.

The engineers' rest room is a one-story brick building 24x84 feet, resting on a concrete foundation, and it is fitted with all modern conveniences, including metallic lockers, showers, concrete floors, etc. Two 18-inch Globe ventilators are provided and the heating is entirely by direct radiation.

The store house is 30x98 feet with an 8-foot basement. Near it is the oil house, smaller in size, but similar in construction. The floor and basement walls of each are waterproofed with asphalt mastic and burlap. The Bowser system of oil storage is used. The coaling station is a 250-ton wooden station of the Holman type. Sand storage is of the usual type. There are two cinder pits with a depressed track between them, the material being handled by hand. A view of one of the pits is shown.

Water is supplied by seven wells, storage being provided for by three elevated steel tanks of 150,000 gallons capacity each. These may be seen at the right in the general view of the terminal. A special line on high pressure supplies fire



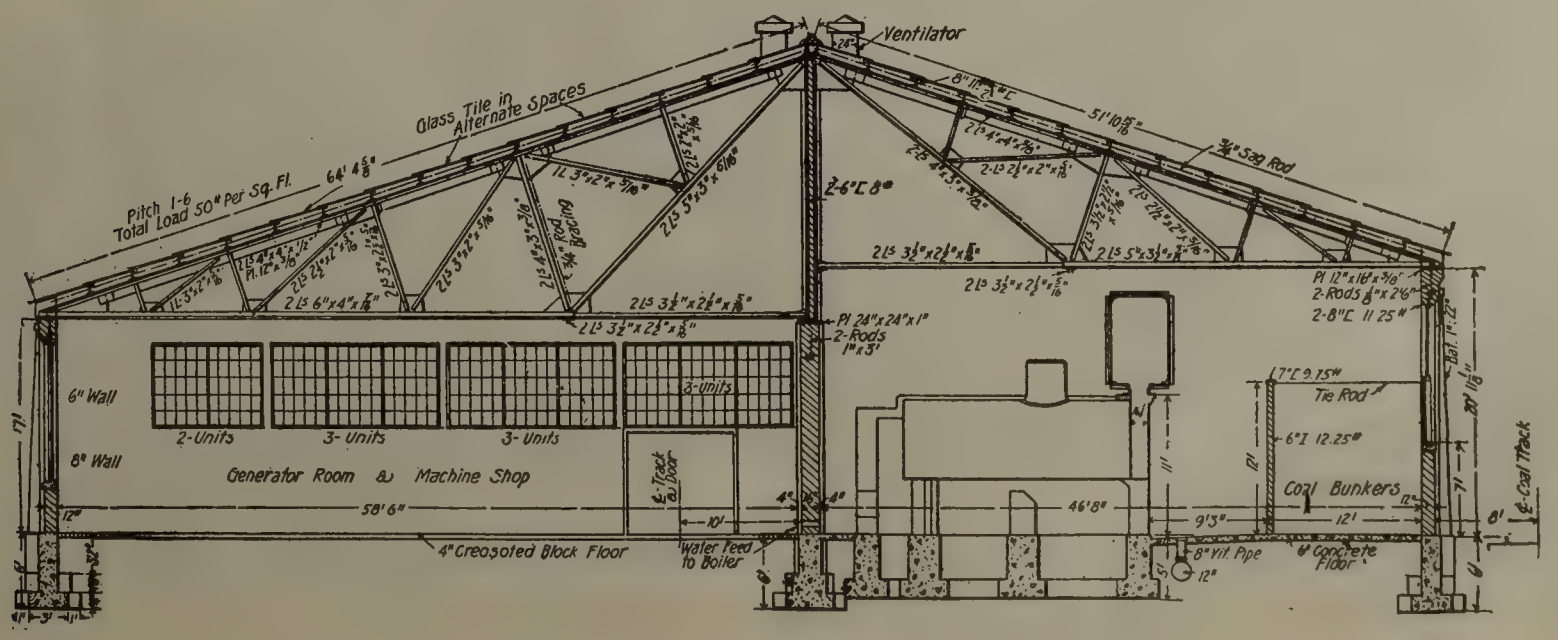
Corner of Machine Shop, Proviso Terminal.

protection, hydrants being supplied through a 14-inch cast-iron pipe. Sewers are of 6-inch vitrified tile. The terminal was so laid out as to allow the future construction of another 58-stall roundhouse just west of the present one, when occasion requires. H. H. Decker, engineer maintenance of way, had supervision of the work, assistant engineer B. R. Culp being in direct charge.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.

The International Railway Master Blacksmiths' Assn. held its 20th annual convention in Chicago, Aug. 20-27. The non-member speakers were H. T. Bentley, assistant superintendent of motive power, Chicago & North-Western; T. H. Curtis, mechanical engineer of the Chicago Association of Commerce smoke abatement committee; and C. W. Cross, superintendent apprentices, New York Central Lines.

Mr. Bentley spoke in part as follows: The blacksmith shop is one of the most important parts of a railway shop plant, for in most cases when material is held up in the smith shop it affects the output of various other departments. On a recent trip to England one of the things that impressed me most was a drop forge shop which had about 50 hammers. There was not anything, from a watch spring to an anchor, which they did not make under the drop forge, and the work was very satisfactory. After it was finished under the hammer there was nothing more to do to it. That is one thing we are careless about in this country; the tendency is for the blacksmith to leave a certain amount of stock on a forging for the machinist to take off. It should be understood that every one who is working for a railway is doing so for the purpose of helping pay dividends and keeping the public satisfied. The officers have the stockholders to please, and unless they can get returns for the money invested they cannot stay in business very long. There-



Machine Shop and Power House at Proviso.

fore it is for every man to try and reduce the cost of production, and it certainly seems to me that there is a possibility of doing this by the extensive use of drop forgings. I have been told that your association is 20 years old today, and from appearances it seems that it has had a very healthy growth since it has been in existence. I believe that any convention that tends to help the men get together and learn what the other fellow is doing, is something that should be supported by your superior officers.

President Hoeffle spoke briefly as follows: The opportunity for the members of this association to take part in convention exercises such as these is a valuable educational experience. It enables each member to measure himself by coming in contact with others. We are not here as individuals, but as representatives of the railways for the purpose of devising ways and means for better methods in doing our work. The art of blacksmithing is not a finished one; that is, there is still considerable to learn concerning it. The very best minds in the world today are men who not only follow their vocations, but who make individual efforts to improve their efficiency through study and reading literature concerning their work. We should constantly be looking to improve ourselves, so that as the art progresses and new propositions are presented to us we will be fully capable of handling them. There is no place in the industrial workshop where more hard work, closer and more conservative calculations, and keener insight are required than in the forge and blacksmith shops. There is no class of men who watch the actual performance of the work in their departments more closely than the master blacksmith, in order to insure the safety of the public, who depend upon the strength and thoroughness of his work.

The methods of handling flues in the shop were discussed, special consideration being given to superheater flues of large diameter. The question of whether flue welding should be directly under the boiler shop or blacksmith shop was discussed, but no definite conclusions were reached, some thinking it should be under one, while others thought it should be under the other.

Special attention was given to high speed steel, as it is getting to be more common in the smith shops, and there still seems to be some question as to its treatment for various uses. It was generally acknowledged that the estimating of temperatures of these steels by their color could not be accurate within 200 or 300 degs. F., and the pyrometer was considered essential to get the proper results. However, the pyrometer should be carefully checked up and calibrated frequently to be sure that its readings are correct. One member uses the fusing point of common salt, which fuses in the neighborhood of 1,465 deg. F., as one way of checking up his pyrometer. The question of why taps and reamers bend while being tempered was considered and various reasons were given for their doing so.

The reports on the subject of drop forgings considered largely the making and design of the dies. In a paper by John Cunningham, the location and design of the drop forge shop was considered. Mr. Cunningham said in part: "The location and design of the drop forge shop should be carefully considered, for owing to the nature of the work the shop will become exceedingly hot, thus decreasing the efficiency of the men and the output. The building should be situated so as to get as much fresh air as possible, and should be so constructed that during the summer months the sides and ends may be entirely opened, the ventilation being as important as the light. The building should be long and narrow and not over 70 ft. wide, which will allow ample space for two rows of hammers and furnaces. An overhead trolley system should be used for handling the dies and a ram for driving the keys holding the dies to the hammer."

Methods were described for case hardening various kinds of material. The question was raised as to whether or not the railways were spending too much time in doing this class of work. It was granted that the longer the material was in the furnace the deeper the case hardening would be, but the question was raised as to whether this hardened surface would not be deep enough if it only remained in the furnace one-half the time, for in many cases the part would not be worn down to the full depth of the ordinary case hardening before the lost motion would require the piece to be replaced. On the other hand, it was stated that the interior of the material itself would not be in as good condition as when the piece was kept in the furnace for a longer time.

Photographs and drawings were presented to the convention showing various dies and formers used on bull-dozers and forging machines. These are of special interest at this time because of the great amount of such work that must be produced by the railways in making safety appliances for cars and locomotives. The material for making the formers was considered, as well as the way in which they should be treated. In many cases cast iron formers are used with steel inserts. G. W. Kelly, Central of New Jersey, at Elizabethport, N. J., spoke on forging machines as follows: "We have a 5-in. universal Ajax machine, driven through gears by a 40-h. p. motor, and a 3½-in. machine equipped with the automatic control made by the Monitor Controller Company. The machine is started by simply pushing a button attached to the machine near the clutch of the locking lever. This will energize a series of relays in the controller box on the wall, which are so adjusted that the current fed to the motor will not overload the circuit and damage the motor. The system is so regulated that the machine will ordinarily attain full speed in about six seconds from the time the button is pushed. The machine is stopped by pushing another button. The system saves time for the operator, as there are no belts to shift, no switches to pull, and no rheostat to fool with. For the company there is a saving of electricity, as the machine will more likely be stopped when not in use; a saving in the life of the motor and perhaps in the wrecking of the machine. The machine may be "inched" along as readily as before and the system, on the whole has proved satisfactory."

On the subject of springs, H. D. Wright, of the Cleveland, Cincinnati, Chicago & St. Louis, Beech Grove, Ind., made an investigation of spring steel to see what would happen to the steel by resetting and tempering it 20 times in the same way as he would any spring that came into the shop for repairs. He found that a ⅜ in. x 3½ in. x 22 in. plate, which weighed 8 lbs. 8½ ozs. when new, would lose 1 lb. 8½ ozs. in weight and also that the steel gained 0.005 per cent sulphur, and lost 0.03 per cent manganese and 0.05 per cent carbon. It was stated that the most economical way of repairing springs would be to have one spring plant on the system located near the general store, so that any new or repaired springs would be directly under the charge of the store department, and requisitions for new material could be easily filled.

It developed that there are a large number of shops that use thermit to weld frames. The advantages obtained from thermit were said to be that it was easily made and that by making the weld a little larger than the original section of the frame it would stand up well in service. The proper annealing of the frames before they are put in service was a point that should be carefully considered. It was suggested that the annealing of parts of the frame to relieve strains after welding did not have any beneficial effect and in fact was often times detrimental. Various systems of making welds were discussed. Mr. Wright, of the Cleveland, Cincinnati, Chicago and St. Louis, stated that it was his belief that a large proportion of the frame breakages could be charged to the improper churning of the frames at the risers when they were being cast. It was generally conceded that there is always an element of danger in a weld, for although an expert welder may make it to the best of his knowledge he is not absolutely sure that it is true.

The following officers were elected for the next year: J. T. McSweeney, Baltimore & Ohio, Baltimore, Md., president; H. E. Gamble, Pennsylvania, Altoona, Pa., first vice-president; T. F. Buckley, Delaware, Lackawanna & Western, Scranton, Pa., second vice-president; and A. L. Woodworth, Cincinnati, Hamilton & Dayton, Lima, Ohio, secretary-treasurer.

Personals

J. O. Enockson, roundhouse foreman of the Chicago, St. Paul, Minneapolis & Omaha, at Altoona, Wis., has been appointed master mechanic, with headquarters at Sioux City, Iowa.

A. J. Baumbush has been appointed general foreman of the New York Central & Hudson River, at the Grand Central Terminal, New York. He will be in charge of inspection, repairs and cleaning of all equipment entering the terminal, whether owned by the New York, New Haven & Hartford on the New York Central.

W. A. Webb, assistant to the president of the Missouri, Kansas & Texas Railway and the Texas lines of that company, has been appointed general manager of the same properties, with office at Dallas, Tex., and his former office has been abolished, effective September 1.

G. R. Berger has been appointed assistant superintendent locomotive fuel service on central division, St. Louis & San Francisco R. R. vice J. E. Smith, assigned to other duties.

Elliott S. Wortham, assistant to the vice-president and purchasing agent of the Chicago & Alton at Chicago, has been appointed manager of purchases and supplies, with office at Chicago, and the office of purchasing agent has been abolished.

Samuel M. Felton, president of the Chicago Great Western, with office at Chicago, has been appointed also receiver of the Pere Marquette, succeeding Newman Erb, resigned.

George F. Laughlin has been appointed acting general superintendent of the Armour Car Lines, with office at Chicago, succeeding T. H. Goodnow, resigned to accept service with the Chicago & North Western.

W. G. Brownlee, general transportation manager of the Grand Trunk, with office at Montreal, Que., having resigned, the office of general transportation manager has been abolished. Division superintendents, superintendent car service and others formerly reporting to the general transportation manager, will, until further notice, report to the vice-president in charge of operation.

E. L. Burdick, assistant engineer of tests of the Atchison, Topeka & Santa Fe, with office at Topeka, Kan., has resigned to go with one of the Westinghouse companies. Effective September 1.

F. L. Carson has been appointed master mechanic of the San Antonio & Aransas Pass, with office at Yoakum, Tex., succeeding T. F. Sullivan, resigned.

H. G. Burnham, chemist and engineer of tests of the Buffalo, Rochester & Pittsburgh, at Du Bois, Pa., has been appointed engineer of tests of the Northern Pacific, with headquarters at St. Paul, Minn.

W. J. Kelsey has been appointed assistant superintendent locomotive fuel service on Rolla subdivision of the eastern division, St. Louis and San Francisco R. R. with headquarters at St. Louis, vice G. R. Berger, transferred to the central division,

E. G. Chenoweth, mechanical engineer of the Erie Railroad, at Meadville, Pa., has been appointed assistant superintendent of the car department of the Chicago Terminal division of the Rock Island Lines, with office at the 124th street shops, Blue Island, Ill.

Walter L. Ross, vice-president in charge of traffic of the Toledo, St. Louis & Western, and the Chicago & Alton, with headquarters at Chicago, has been elected president of the Toledo, St. Louis & Western, succeeding T. P. Shonts, effective September 1.

Among The Manufacturers

MOORE SYSTEM OF FREIGHT CAR HEATING AND REFRIGERATION.

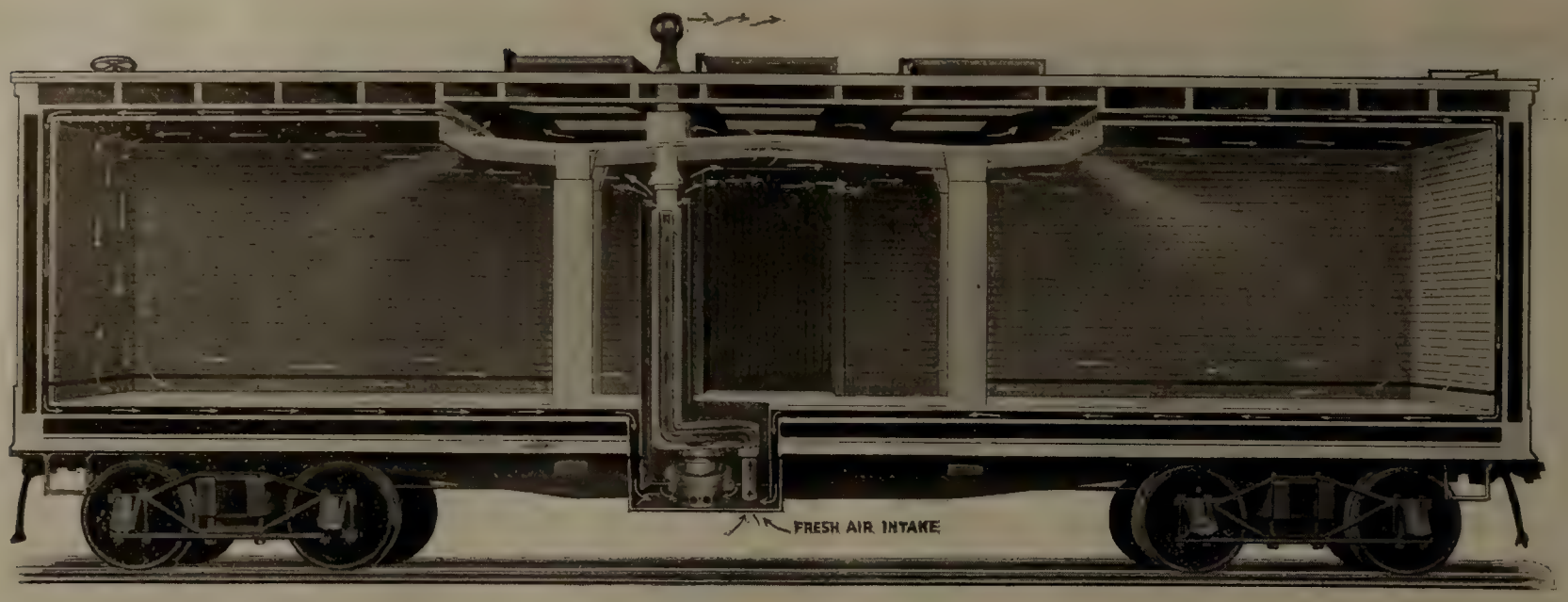
The Moore Patent Car Co., St. Paul, Minn., has developed a new and interesting system of heating or refrigerating car used in the transportation of perishable freight.

Refrigerating System.

The Moore system is based on the natural law of gravitation and is sanitary. The warm air, gas and humidity arising from the lading passes into the ice bunker through the openings at its ends and the heat penetrating the walls of the car enters a live air space (containing converging ducts) which convey it to the ice bunker; the air then becoming chilled drops through the ports in the center of the bunker, passing through the load to the floor of the car, circulating to each end, absorbing heat, humidity and gas. The air again ascends and re-enters each end of the bunker, where it is purified by contact with the ice, then falling through the center ports making the circulation complete. This performance continues as long as there is any heat, gas or humidity in the load, or heat penetrating the walls of the car. The air in cars equipped with the Moore system of circulation is equalized to safe temperature in a few hours.

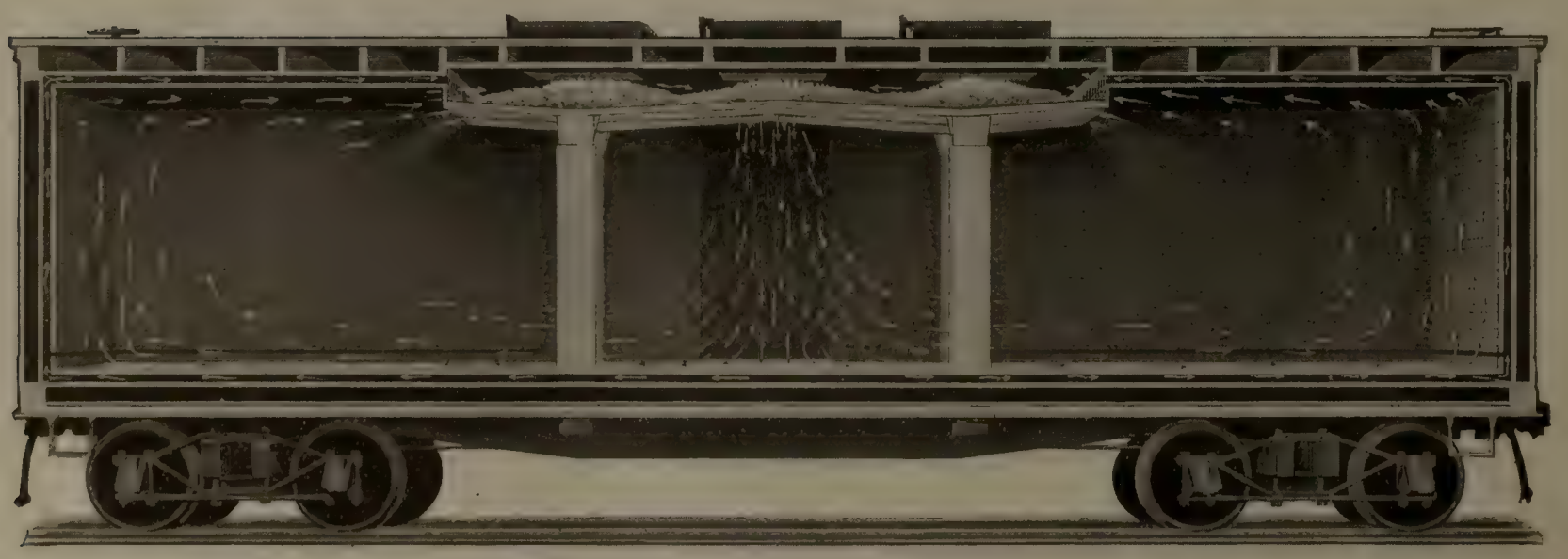
The ice bunker is placed in the top center of the car, thereby increasing the floor space and loading capacity of the car 19 per cent. The ice bunker is 8 feet by 16

Air Circulation Under Ventilation with Car in Motion.



Air Circulation Under Heat.

General Appearance of Car Equipped With Moore Refrigeration System.



Air Circulation Under Refrigeration.

Interior of Car Equipped with Moore System of Heating and Refrigeration.

feet by 18 inches. Protruding tee irons in the bunker prevents the ice from shifting when the car is in motion. Four large drains carry off the water from the bunker.

The weight of the Moore car, empty or loaded, is so distributed that it is equalized upon the trucks, facilitating its operation upon the bearings.

Complete circulation of the air in the Moore system keeps the car dry at all times, permitting its use for the transportation of merchandise, making it a general utility car. The rotting of floor, sills and walls is greatly reduced.

Heating System.

Fresh air is taken from the outside through a by-passageway in a heating drum where it is heated and exhausted into the car above the load line, circulating through the air ducts in the walls, ceiling and floor, and provision chamber, around and through the load to the stove and check draft out through a smoke stack, removing the cool and vitiated air, thus forming a complete circulation of fresh warm air in and around the load. The heater is placed under the side center of the car, obviating the necessity of opening the doors of the car. No gas or smoke enters the car. These cars have been successfully operated in peddler service with the thermometer forty degrees below zero, Fahrenheit.

Ventilating System.

There are six hatchways equally distributed over the ice bunkers, three on each side opening in opposite directions. When the car is in motion the covers opening to the head of the train form a hood, causing an inlet of fresh air which circulates to the rear end of the car where it is deflected and forced to the forward end, causing evaporation of the moisture which cools and reduces the humidity, gas and heat in the load. This atmospheric pressure forces the foul air and gas out through the three opposing hatchways. This results regardless of the direction in which the car is moving. The Moore car under load can be changed from ventilation to heating in the winter and to refrigeration in the summer without opening the car.

GRAPHITE LUBRICATOR FOR LOCOMOTIVE CYLINDERS.

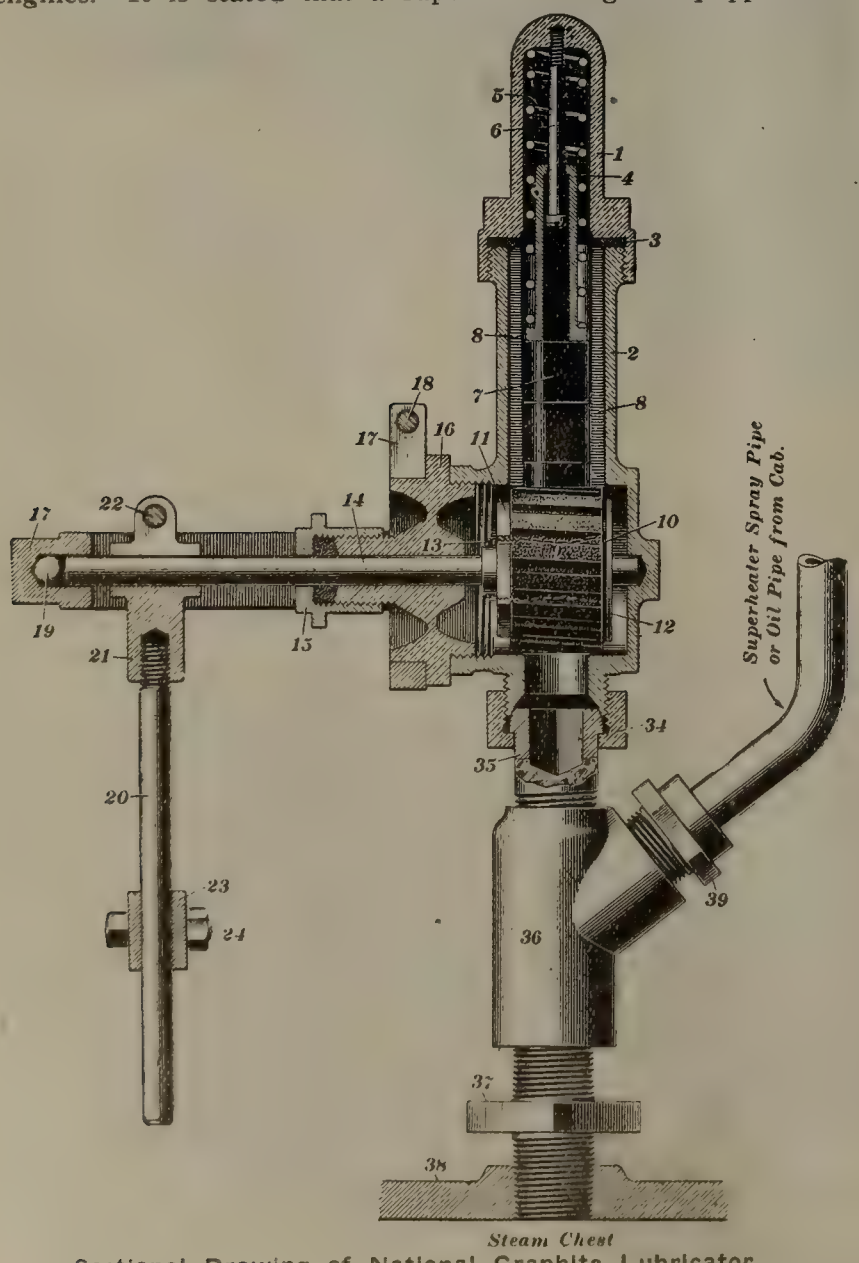
A graphite lubricator adapted to the lubrication of locomotive valves and cylinders is shown in the accompanying illustrations. The device is the invention of L. S. Watres, and is manufactured by the National Graphite Lubricator Co., Scranton, Pa.

This lubricator is intended to distribute a small amount of graphite on the walls of the valve chest and cylinder each stroke of the reciprocating parts. The lubricator is mounted on the top of the valve chest and motion is obtained from the valve stem or combination lever of the valve motion. The graphite, which is in the form of pressed cylinder, is fed down upon a grinding wheel which makes a part of a revolution each stroke. A small amount of powdered graphite is thus dropped into the steam space.

Few will find objection to the use of graphite, and the good results obtained by its use are well known, the difficulty, heretofore, has been with means and methods of its use. The necessity for the use of graphite is particularly beneficial in connection with superheater engines where some lubricating difficulty may have developed.

National Graphite Lubricator as Applied to Slide Valve Engine.

The device in question is in use on a number of locomotives of the Delaware, Lackawanna & Western, where it has proven very successful in reducing valve troubles, steam blows, and excessive friction. The photographic illustration shows the apparatus mounted on the valve chest of a saturated steam locomotive. It is in use on both superheater and saturated steam engines. It is stated that a superheater engine equipped with this device has made 30,000 miles without attention to packing rings and that the cylinder interior is in excellent shape. The graphite used is furnished by the manufacturing company at a nominal cost. It is about 98 per cent pure.



Sectional Drawing of National Graphite Lubricator.

NEW FLAT TURRET LATHE.

The Modern Machine Tool Co., Cincinnati, Ohio, has recently designed and is now building and putting on the market a new flat turret lathe. It is made from entirely new designs, massive in its construction and embracing all the features of the best and most modern forms of lathe construction. Each part being designed so as to be commensurate with the strains to which it is subjected; the machine affords that rigidity so necessary to the total absence of vibration so requisite in the production of accurate work and perfect surfaces.

The "Modern" is built with all of its parts extra heavy so that it is capable of handling a gang of tools of extra sizes and taking extra heavy cuts with ease. Yet, the machine is easy to handle, convenient in every detail for the operator.

The construction and extra size of parts and bearings give increased strength and additional weight in those places which are usually made too light to withstand the heavy duty required at high speeds, and the exceptionally severe strains caused by the use of high speed steel when taking very heavy cuts. This prevents chattering, which is destructive to the cutting tool, and causes the general wearing out of the machine before its time, and leaves the product unsatisfactory.

The cone and gears give the machine twelve spindle speeds in geometrical progression, ranging from twenty-four to 465 R. P. M. The bed rests on a three-point bearing, is extremely deep and heavy, crescent-shape formed and re-inforced under the front spindle bearing, which gives great strength and rigidity at the points where most needed and eliminates vibration under the heaviest cuts.

This machine is manufactured on the unit system of construction, eliminating, to an appreciable extent, individual fitting in the assembling of the lathe, and insuring interchangeability of parts. Plain bearings are scraped to master surface plates and straight edges, shaft bearings are ground, fitted with suitable removable bushings, which may be replaced when worn without disturbing the alignment of the shafts, while all sliding surfaces and revolving parts are provided with liberal and efficient means of lubrication readily accessible.

The belt shifter is operated by the hand wheel in front of the head within easy reach of the operator. The motion from the hand wheel is transmitted to the belt loop through an intermittent rack and pinion. A similar device is suspended from the countershaft and operates in unison with the device on the head through the knuckle joints and connecting rod, as shown. The belt loops are so timed that a half turn of the hand wheel to the left shifts the belt from the larger step to the smaller step on the head, while the loop on the upper device holds the belt out of contact with the edges of the cone on the countershaft. The next half turn of the hand wheel moves the upper loop in line with the corresponding cone on the countershaft. Thus, it will be seen that one turn of the hand wheel shifts the belt from one step to another in either direction.

The automatic chuck is operated by a single movement of a lever in front of the head. It has a strong and unyielding grip, no over hang, no end motion, no changing of the jaws. One set of jaws is adjustable for the full capacity of the machine. The jaws and seat are hardened and ground. This chuck is constructed for handling rough bars. The jaws are of unbreakable form and may be read-

ily made for any size and shape within the spindle's capacity.

The automatic roller feed is very simple in design, has only three moving parts or members, each of liberal proportions, thereby avoiding frail construction. It is mounted on the spindle just back of the front bearing. It is operated by the same lever and movement that opens the chuck and operates only when the chuck is open.

The feed gear box is driven from the spindle. Eight feeds are obtainable instantly, ranging from .005 to .085 per revolution of spindle and may be operated in either direction. These feed changes are obtained by means of the lever and crank handle shown at the front of the gear box. Motion from the feed box is transmitted through a disc friction and knuckle joint through the carriage feed rod. The gears, cone pulley and all moving parts are covered to prevent injury to the operator.

The carriage has a system of 12 stops so arranged that two may be used for each tool. A steel cover plate in the form of a slide is provided to close the opening containing the carriage stops which gives easy access to the stop for oiling and inspection. A binder is provided for securely clamping the carriage to the bed during forming and cutting off operations. The backward movement of the carriage automatically turns the turret to each position the instant the tool leaves the work, and is so arranged that it may be turned to any one of the six positions without making any other stops. The adjustable dog for operating the index bar is clamped to the V and governs the position of the saddle at the time when the turret begins to revolve. The carriage is provided with independent adjustable stops which operate automatically for each position of the turret and may be operated in any desired combination when two or more are needed for any position of the turret.

Bar stock up to 2¼ inches in diameter can be fed through the automatic chuck and turned any length up to 26 inches. The swing over the bed is 20 inches; over the carriage, 16 inches. The spindle has a front bearing 4⅜ ins. diameter by 7½ ins. long and rear bearing 3½ ins. diameter by 5½ ins. long.

The turret is 18 inches in diameter, provided with T-slots of ample proportions, thus permitting the use of substantial planer head bolts for securing the turning tools to the turret. These can be secured one back of another for turning several diameters at one movement of the turret, thus eliminating the objectionable stud-bolt. The index is very large in diameter the lock bolt is located directly under the working tool, and so close to it that there can be no lost motion between the tool and the locking pin.

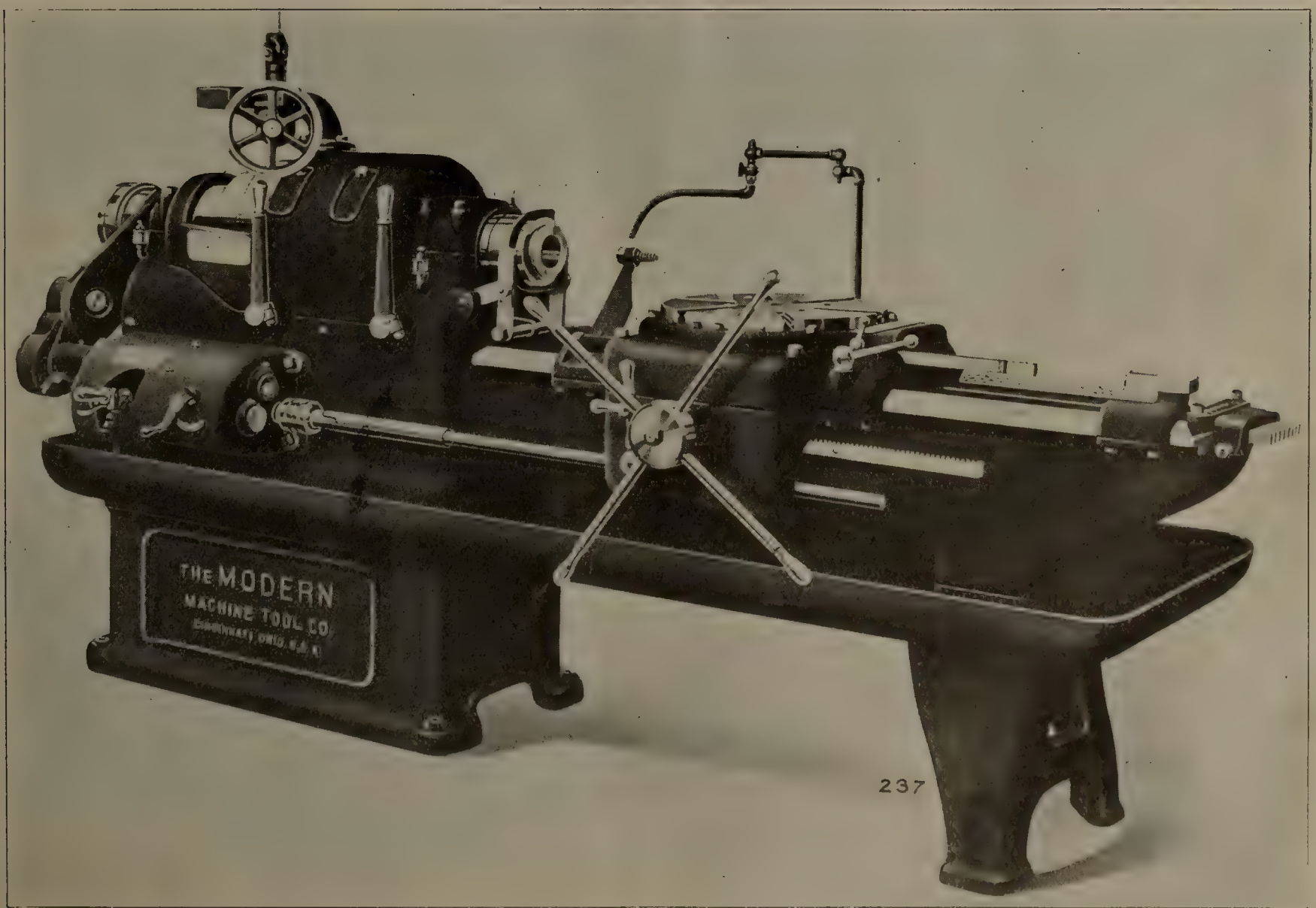
The net weight of the machine is 4,500 pounds.

New Literature

Bulletin No. 36 illustrating and describing the Economy steam turbine has just been issued by the Kerr Turbine Co., Wellsville, N. Y. Photographs of actual installations are shown, interesting steam consumption curves are given and size comparisons are made.

* * *

"Baldwin Westinghouse Electric Locomotives" is the title of a handsome booklet recently issued by the Westinghouse Electric & Mfg. Co., of E. Pittsburgh, Pa. To one interested in electric locomotives (and every one should be these days), it contains a great deal of interesting information.



Modern Flat Turret Lathe.

Descriptions and illustrations of practically all types of electric locomotives are shown.

* * *

Catalog No. 87, describing and illustrating the new Watson-Stillman hydraulic coupler yoke shearing and riveting press, has just been published by the Watson-Stillman Co., 50 Church street, New York. This machine shears riveted coupler yokes from their couplers or clamps and rivets the couplers and yokes together with a single stroke of the ram.

* * *

The Westinghouse Electric & Mfg. Co., of E. Pittsburgh, Pa., has issued a booklet descriptive of Westinghouse switchboard indicating meters. It is divided into four subjects as follows: Modern Tendencies in Design, Advantages of Induction Meters, Westinghouse High Grade Meters and Theory of Induction Meters.

* * *

The automatic connector is fast gaining a place in the railway world. Therefore a recent pamphlet by the Robinson Coupler Co., of Washington, D. C., on the Robinson connector is of especial interest. This connector contains but three essential parts—two castings and a strong spring, and weighs between 35 and 40 pounds. It uses standard fittings and goes on where the present hand coupling is taken off.

Industrial Notes

Henry C. King has been elected president and general manager of the American Mason Safety Tread Company to take that office made vacant by the death of William S. Lamson, who died at his home in Lowell, Mass., August 16, 1912. Mr. King has been treasurer of the above company since its organization and in that time has made many friends among railroad officers.

The Halcomb Steel Company, Syracuse, N. Y., has opened a sales office at 95 Liberty street, New York, in charge of F. W. Ross.

Olin, Gilberson & Hilands, Inc., eastern selling agents for the Sligo Iron & Steel Co., Connellsville, Pa., the Keystone Tube Works, Inc., Uniontown, Pa., and for the Central Tube Co., Pittsburgh, Pa., have moved their offices from 2 Rector street, New York, to 30 Church street.

The Keith Car Co., of Chicago, has increased its capital stock from $30,000 to $100,000.

The Oxweld Acetylene Co., Chicago, will build an addition to its plant, 50 x 75 ft., at an estimated cost of $10,000, to be occupied by the welding department. R. S. Lindstrom is the architect.

The Union Car & Equipment Co., of Chicago, has been organized with a capital stock of $250,000 to manufacture railroad equipment. The incorporators are: W. G. Davis, A. L. Jacobs and R. Davis.

Henry W. Jacobs, who has resigned his position as assistant superintendent of motive power of the Atchison, Topeka & Santa Fe, is now president of the Oxweld Railroad Service Company and director of mechanical matters for the Jacobs-Shupert U. S. Firebox Company, with office in the Railway Exchange, Chicago.

On August 1 Robert W. Hunt & Company, Chicago, assumed the inspection of locomotives and passenger equipment for the Illinois Central. In addition to the superintendence of construction at the various locomotive and car plans, the service will include the inspection at point of manufacture of various specialties entering into the construction of the locomotive.

Wilber C. Cook, Office Manager, Grip Nut Co., Chicago.

The Moore Patent Car Company, St. Paul, Minn., has moved its main office to the Germania Life building, St. Paul.

Wilbert C. Cook has been appointed office manager of the Grip Nut Co., Chicago. Mr. Cook entered the employ of the Chicago, Milwaukee & St. Paul Railway as messenger boy in December, 1884, and was advanced through the car department to the position of chief clerk, which he resigned in December, 1899, to become chief clerk to the master car builder of the Swift Refrigerator Transportation Company. In April, 1907, he entered the service of the Armour Car Lines as auditor of shop accounts, remaining in that position until January, 1910, when he resigned to enter the service of the Western Steel Car & Foundry Co. as buyer in the purchasing department. He left that position on September 1 to become office manager for the Grip Nut Co. Mr. Cook has been active in the work of the Car Foremen's Association of Chicago, having served as secretary during the early history of that organization.

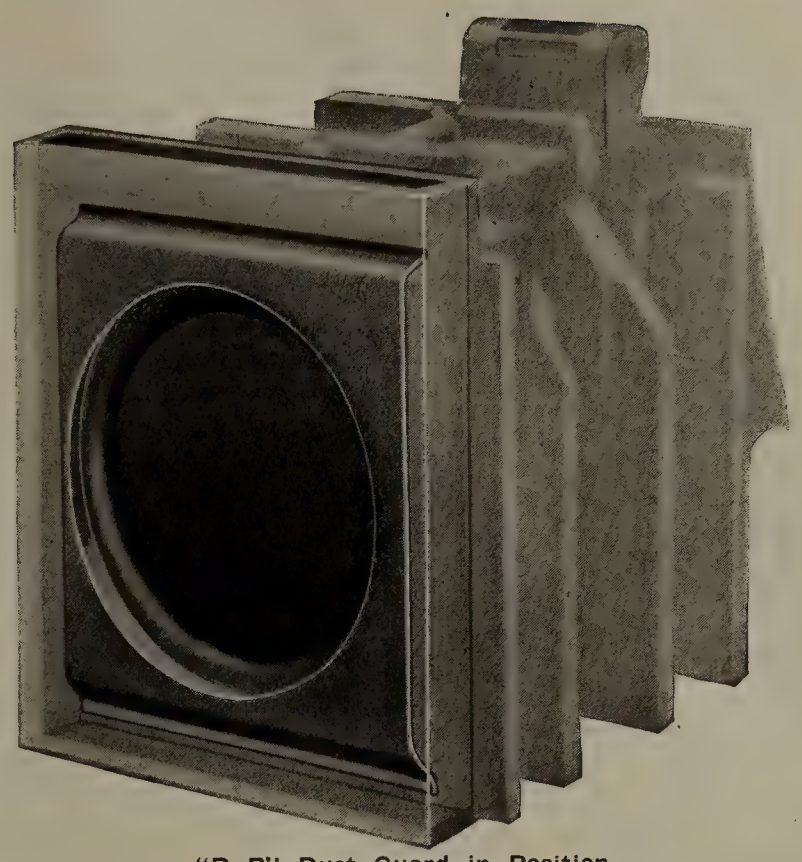
"D P" Dust Guard Partially Inserted in Slots.

THE "D. P." DUST GUARD.

The question of the exclusion of dust and foreign matter from car journals is of considerable interest and great importance. The ordinary type of dust guard has proved itself anything but a satisfactory means to this end, and the many difficulties arising from the use of the ordinary wooden dust guard are too well known to need detailing here.

The illustrations herewith show a one-piece metal dust guard for car journal boxes which has been successfully in service for about two years. The device is of one piece spring metal construction; is practically indestructible, and once installed it continues performing its function efficiently during the life of the car.

In service, it is demanded of a dust guard that it maintain its proper position without hanging on the axle, thus eliminating wear to either part. The "D. P." guard is forced into position and the buckling action in the steel plate utilizes the entire area of the guard as a powerful spring compressed between the walls of the dust guard slot. An automatic report on one of these dust guards shows that after having made 30,000 miles in service, there was no distinguishable wear at the top of the circle, showing that it was not bearing on the axle. The guard is made in all sizes for use on either cars or locomotives, and has been placed on the market by the Grip Nut Company.



"D P" Dust Guard in Position.

Proceedings of the Thirteenth Annual Convention, Chief Interchange Car Inspectors' and Car Foremen's Association of America

The thirteenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Assn., was held at the Palmer House, Chicago, August 27, 28 and 29, 1912. President F. W. Trapnell, of Kansas City, called the meeting to order and spoke as follows:

We have assembled at this time for the thirteenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, in Chicago, for the reason that we believed it was centrally located and there was lots of wind. The Chamber of Commerce has advised us that they have sent over one of their most eloquent speakers to give us cordial welcome to the city. They do not say anything about a golden key. Nevertheless, I have no doubt but that we will be more than welcome, and if we should perchance be worked into any difficulty, the citizens of Chicago will see that we go free. I have the pleasure of introducing to you Edward F. Trefz who will now address you.

Address of Edward F. Trefz.

Mr. President, Ladies of the Chief Joint Car Inspectors and Car Foremen's Association, and Gentlemen: That is about as bad as my name to get. It gives me a great deal of pleasure to come here at this time to talk to you. I haven't any golden key but the president of the Association of Commerce took it for granted that individuals who have the mechanical ability that you have ought to be able to break into anything without a key, consequently he has given you full permission to do that, and if anything should occur that will be annoying, if you will just call up Main 4808, we will try and see that you are extricated and brought out of that difficulty without any further annoyance to yourselves.

I am more than delighted to extend this welcome to you, not only because of the position you hold in the industrial world today, but because of the fact that any man who attends a convention in Chicago and brings his wife must be a pretty respectable citizen in his own community.

You hear a good deal about Chicago, not alone our windiness, but other things. A few months ago I was down to Cleveland talking to the Garment Manufacturers' Association. One of the members of the Association who was from Chicago went down in the lobby to telephone to a friend in a little town about a mile and a half away outside of the city limits. When he stepped out of the booth he said, "How much is it?" The girl said: "$1.00." He said: "In Chicago I could telephone to Hell and back for 10 cents." And quick as a flash the girl said: "Certainly, but that is in the city limits there."

Merely to intimate that our city is cosmopolitan. All who live in Chicago are industrially a part of this great cosmopolitan city, holding in itself the three great metropolis, East, North and South Chicago, the City of Chicago represents one of the most amazing and most astounding cities in the history of the world. When you remember that it took New York more than 350 years to do what Chicago did in less than seventy-five years you begin to understand what it is. It is splendid and great and it is somewhat of the dark and somewhat of the evil. It is dark, and yet you remember that Chicago has the finest system of children's playgrounds anywhere. We have more miles of beautiful boulevards than any city in the United States. We have more beautiful parks than any city outside of Berlin and Paris. Our libraries take their place among the great ones of the cities of the world. Chicago has art and culture. I need not say anything about the industrial worth.

What made the city of Chicago? There is positively no excuse for a city being here on the sand dunes. Michigan City is far better located than Chicago. Every railroad has got to jog around the bottom of the Lake. Men like Phillip D. Armour, men like Crane, men like Ryerson—men who saw the tremendous power of the great granaries of the West, the men behind the railroads, individuals with magnetism, personality and power. That is the reason we love Chicago, and that is the reason we are like the traveling man who went down to New York City. When he sells to a man he is supposed to treat him with courtesy, but these men were sitting in the lobby and they got into a dispute as to the merits of New York and Chicago. Finally the traveling man arose and said: "All you got is Broadway, and I would rather be a lamp post on State Street in Chicago than Mayor of your town. We think it is the greatest city the world has ever seen." Enough of Chicago.

I am glad to welcome you here because you represent unity in endeavor. This old world has long been a world in which competition has been bitter, a time when the competitor did not believe he was a success until his competitors were on the toboggan slide on the road to ruin. Today they realize that helping one another is a splendid thing. You will notice that big men attend a convention of this kind because they are ready to give aid and they know that every man has something to tell them. Therefore this convention represents unity, increased efficiency and a forward step in the world's civilization.

It is team work in the world that wins, shoulder to shoulder advancing. You men have a tremendous responsibility resting upon you. Last year I traveled forty-four thousand miles, and I never took my place in a coach or sleeper; I never followed the engine anywhere but I just thought of the ability of the person who was responsible for the car in which I was riding, not because I feared any crash. One night on the New York Central, the Twentieth Century, the rear trucks gave way and sprang down under our car. When they stopped the train I got up and saw the front end was pointing out toward the stars. God Almighty only knows why it did not go over the banks.

We feel that it is safe to hand over this precious old city in your hands, and if there is anything we can do to make your stay pleasant we will be glad to do it. We trust that you will have a good time and a splendid convention. And when you leave our city you know it will have a little bit better estimation of combinations and trusts than it ever had before. We have splendid markets here, and you men will feel that you are just a little bit better in your own work and a little more efficient in the works that you are going to accomplish because you have been in this great old city that stirs the blood and makes you feel like the old Grecian when he said: "The trophies of Artemus will not let me sleep." There is work for each one of us and let us do it the best that we can.

President Trapnell: I will call upon Mr. T. J. O'Donnell to respond.

Mr. O'Donnell: I feel that I am not capable of replying to the golden remarks of our honored brother in a manner befitting the occasion. In fact it was not over five or ten minutes ago that I was told that possibly I would have to say something and in listening to these remarks and also the introduction of our president, it appealed to me before the speaker got half way into his argument that I would apologize for the introduction of Mr. Trefz in so far as that word "windy" was concerned, but after listening to the gentleman I trust he will pardon us as humble citizens of the stars and stripes if he won't get down on his knees and say the title is aptly and properly given to Chicago. However, I would be ungrateful to the highest attributes of the human heart if I did not make an effort to say a few words showing the appreciation of this body to this honored gentleman from the great city of Chicago. We have come to your city for business and pleasure. We come as strangers in the majority, and I know that we will leave your city as brothers and sisters of the citizens of this glorious commonwealth of Illinois. We hear from Chicago very often as to what they are accomplishing. Anything that betters humanity, we raise our hats and say: "All hail to the City of the West." We in the east, of the Empire State, appreciate our great metropolis, New York City, but for progress and advancement Chicago is the only city under the stars and stripes to my mind that will ever take the advance and the lead in our glorious country of America, and we hope that the City of Chicago, with all its complements on the side, will cherish these high aspirations and feelings of progressiveness that she cherishes at the present time to further the interests of our country and our nation, so that the most humble citizens can come to our shores and say: "I am free from persecution; I love the stars and stripes; I will lay down my life if necessary to preserve the good feeling of the American Republic." And Chicago helps us to enjoy that good feeling at all times. Now, Mr. Trefz, I wish to thank you. Let Chicago be happy. Let her people feel that the reputation of the worst side is only a small reflection of the good side. May your citizens always be our best people, and may we come to Chicago at all times, individually or collectively, to enjoy its confines in the best spirit of friendship and brotherly love. On behalf of this association, Sir, I thank you, and I hope that we will leave your city with the best feelings of having had a royal good time, and that our friend from Kansas will drop the word "windy" when speaking of Chicago. I thank you.

Address of President Trapnell.

We are assembled here to hold the thirteenth annual convention of this association, to renew old acquaintances and to form new ones, and to discuss the rules of the Master Car Builders' Association, which have been promulgated to govern the interchange of cars, and arrive at a common interpretation of the same. We desire that a car passing in interchange at the Niagara Frontier will pass the same way at the extreme west, north and south, and this can only be brought about by uniform understanding of the rules, and I trust that after this meeting we will all be able to pass on cars without unjustly penalizing any line.

Since the last meeting of this association, a great many of the large gateways have adopted the M. C. B. Rules to the letter, doing away with all special agreements, and carding all cars with cardable defects in interchange, which has been done with very little confusion.

Some inspectors have been close in their carding, and this matter has been taken up with them, and a liberal policy has been preached to them, and the errors in carding have been greatly reduced.

It has been a problem of education to the inspector. Some have taken kindly to it, and others have the idea that they have inspected cars for several years, and know what is required, when you question them on the rules, but they have not kept abreast with the changes. This has been caused by the old style of running on record, and the cards all issued in the office of the Foreman, so that the inspector was not put to a test of what he knew.

Therefore the only system that he knew was to write up all the defects, large or small, that he found on the car, and then shift the responsibility to some one else to card. He was not called upon to use his judgment as to carding, and it was found that after all the instructions given, inspectors would card for owners' defects.

Your executive committee met in Chicago, and made recommendations to the arbitration committee of the Master Car Builders' Association, of the desired changes in the rules from a practical standpoint for those on the ground floor who have to operate them, but that body could not see their way clear to adopt all of the suggestions. They adopted some, but from the practical enforcement of the rule a great many changes could and should be made. However, it is with patience that we await the time when it will finally come to us by continually asking.

A. R. A. Rule 15 should be modified to specifically state the amount of labor necessary to cause a transfer, as the rule is now a car can be transferred for the slightest defect, that could be repaired in two or three hours, and as transferring the car is the easiest method to get rid of the same, this also leaves an opening for sharp practice.

During the past year, interchange bureaus have been established at Denver and Kansas City, and I am informed that the Denver bureau is progressing very nicely, and Kansas City is doing splendidly.

It is slight additional work on the inspector to get the contents and destination, which is shown on the routing card, and the seal numbers, and the ventilation in addition to the physicial defects. This has been accomplished without any additional expense to the mechanical department. The reports are made by the inspectors, and are turned into the office, and typists transcribe the same on regular forms, and one copy is furnished to each car accountant, one to each agent, and one to each mechanical department interested in the interchange. This makes four large points that are now operating this system, that is: Pueblo, Chicago (Stock Yards), Denver, and Kansas City.

I am also pleased to advise you that on April 1st, Chicago adopted joint inspection, and F. C. Schultz was appointed chief inspector. Also Dallas, Texas, put in Joint Inspection with J. W. Hogsett as the chief inspector at Ft. Worth and Dallas, but does not take in the bureau features of reporting to the Car Accountants, etc.

This has been a very good year for the establishment of joint insepection with chief inspectors in charge. Thirteen is proving to be a good number, as the year when adding the figures of 1912 will make thirteen.

During the past year, death has invaded the ranks of this association, and called from active work, C. W. Waughop, Charles Stark, and Mr. Chatman, and I have appointed appropriate committees to report to this association their obituary.

I desire to express my thanks to the members of the entertainment committee and to the friends who have contributed for our entertainment. I feel sure that none of the members need worry about the ladies while they are attending the meeting, as they will be taken care of.

The members of the Entertainment Committee have all arrangements completed, and at the close of the meeting the ladies will have seen the points of interest in and about Chicago, and with the side trip will be well repaid for the session being held in the city of Chicago.

In conclusion, I desire to thank the executive committee for their co-operation in the work, especially the past president and secretary, and I desire to especially thank Past President Boutet's daughter, who has helped me very much in preparing for this meeting. And all of the members for their co-operation and interest shown and I trust that this meeting will repay them as in the past.

The hours of session will be 9:00 a. m. to 12:00 noon; 2:00 p. m. to 5:00 p. m., and I would ask that you all be on hand promptly at the opening, and remain to the close, and at the close of the meeting we will feel the meeting has been very beneficial and that with better understanding business will be expedited and our superiors will be pleased at your efforts.

L. S. Wright: I think it is unnecessary for me to say it means any pleasure to me to be able to greet this little family again this morning. I find that the time is very much taken up and there are a few things that are very essential. In checking over what registration we have we find that there are a great many who have not registered, and that governs a great many of our plans. We will pass out registration cards and all those who have not done so will please register. This afternoon the ladies are to be taken care of by the ladies of this city on a shopping tour. This evening we will have a reception and we hope, a dance. Tomorrow morning the session starts at 9 o'clock. Our plan is to start at 9:30 on an automobile ride for the ladies. Tomorrow afternoon we go on chartered cars to the North side bathing beach. Wednesday evening we go to the theater. On Thursday evening we take the steamer, United States, at the foot of Clark street, for a boat ride.

Under the head of reports of committees the following resolutions of the death of Past President Charles Waughop was read by Mr. Boutet:

The Chief Interchange Car Inspectors and Car Foremen's Association of America is again called upon to mourn the loss of one of its members, Mr. Charles Waughop, Chief Interchange Inspector of St. Louis, who departed this life at St. Louis, July 20, 1912. Mr. Waughop was for 31 years chief interchange inspector at St. Louis and was from 1899 to 1906 president of this association. His long term of office in the important position he held, his devotion to his duty, his ability and efficient service, together with his kind and genial personality made him a man who honored his calling, advanced the interests of those whom he served and made him an influence for good among his fellow men.

The Chief Interchange Car Inspectors and Car Foremen's Association of America feels that in the death of Mr. Waughop the railroad service has lost a valuable servant, the community in which he lived has lost a useful citizen and this association has lost one of it's best and most respected members, who never spared his time, energy and money for the advancement of the interests of this association.

Be it Resolved, That this association deeply deplores the death of Brother Charles Waughop and extends to his family their most sincere sympathy in the hour of their bereavement and directs that this memorial and resolution be spread upon the minutes of this association and a copy be sent to the family of the deceased brother.

J. L. Stark.
H. Boutet,
S Skidmore,
Committee.

Resolutions regarding the death of Member Chas. S. Stark were read by F. C. Schultz, as follows:

Whereas, the supreme and all wise Providence has seen fit to take from among us, our friend and fellow member, Charles S. Stark, at the end of a young and useful life, crowned with the highest respect and affection of his friends and associates, and

Whereas, This association has lost the services and good fellowship of a sincere and earnest laborer in the cause, whose best ef-

forts were at all times put forth for the betterment of this organization, its objects and purposes,

Be it Resolved, That this association bow in submission to Divine Will and in so doing, commemorate the many kind deeds, generous acts and the noble character displayed by our late friend and associate.

Be it further Resolved, That this heartfelt testimonial of our sympathy and sorrow be spread upon the records of this association and that a copy thereof be sent to the family of the deceased.

F. C. Schultz,
T. J. O'Donnell,
W. J. Stoll, Chairman,
Committee.

It was moved by Mr. O'Donnell that the reports be received, made a copy of the minutes of this meeting and a copy be sent to the families of the deceased members; that fifteen minutes be set aside before the adjournment of tomorrow's session for testimonials by friends of each departed member. Carried.

President Trapnell: I believe that we should increase our official force by adding one more vice-president. I think there should be an amendment to our constitution to that effect.

Mr. Boutet: I move that a committee of three be appointed to draw up the proper amendment to the constitution and present the same to the morning session so that it can be acted on by this body before the election of officers. Seconded and carried.

President Trapnell appointed on the committee Messrs. Schultz, Kipp and Bradley.

President Trapnell: There being no further business we will proceed to the reading of the rules.

Mr. O'Donnell: I cannot see the wisdom of reading each rule in this book. Our president has told us we are to have six hours' session each day. I can see no reason why we have our meetings from 9 in the morning until 1 in the afternoon. The most of us want to see Chicago, and as far as interchange is concerned, four hours a day would cover our business session.

I move you that the order of business be suspended to the effect that our meetings, after today, be held from 9 a. m. until 1 p. m. Seconded and carried.

J. L. Hodgson proceeded with the reading of the rules.

The change in the preface was read and on motion duly carried, accepted as read.

Rule 2, Paragraph 1.

Mr. Pendleton: Since our last convention the first paragraph of Rule 2 was the second paragraph in the old book, the interpretation of which has caused considerable contention in the application of M. C. B. defect cards. To make the case plain, one party contends that the rule means from the wording cars having defects for which delivering company is responsible must be properly carded when offered in interchange. When the condition is such that it is the duty of the delivering line to card a car on his line prior to delivery. The other contention is that it is compulsory to card the car when offered in interchange when it is demanded by the receiving line. I would like to have it interpreted. Does it mean that if I make delivery to you that I shall follow the car, or shall I card it in my yard prior to getting to connection and follow it up later and furnish additional protection? Isn't it up to the receiving line to offer the protection?

Mr. Schultz: I understand that this matter was placed before the arbitration committee and they have rules on this particular point. I understand the ruling was that the cars must be carded in delivering line's yard. I may not have it correct, on their own initiative.

Mr. O'Donnell: My understanding is that in compliance with that rule the interchange does not take place until your inspector inspects the cars and finally passes upon them. It is optional which side of the fence the inspectors are on. The cards can be applied in the receiving yards or in the general yards.

President Trapnell: Where you have the interchange inspectors of the receiving line go to the delivering line yard to make the inspection, but where you move up and transfer from the train and delivering line yard and haul from 5 to 10 miles it is necessary that the receiving line shall demand a card before this movement, and I do not believe that the party having the car in his possession bringing it in on the train would carry the car, as the man would desire the carding when received for his specific line.

Mr. Schultz: I feel that the matter as outlined by Mr. O'Donnell is the proper way. I think the delivery of the car, the interchange takes place after having been delivered to the receiving yard with proper billing, etc. This question came up as a matter of interchange at the St. Louis Terminal, and I think it was referred to the arbitration committee.

Mr. Pendleton: I will say that that came up at St. Louis and was referred to the arbitration committee for a correct interpretation of the second paragraph of Rule 2. Mr. Taylor replied to the Secretary of the interchange committee at St. Louis and said he was not in a position to interpret the rules, but he was going to try to see the arbitration committee the following week and would present the case, but personally he felt that it was the duty of the delivering line to card the car. In the first place, the Secretary in writing Mr. Taylor did not make the point plain. There is no one denies that it is compulsory on the part of the delivering line to card the car. We are handling cars independent. I make delivery, as I understand it is my duty to be on the ground and furnish the protection to the receiving line as they demand, but where they have a joint bureau like Chicago and St. Louis we have simply entrusted to each other the writing of the card under joint supervision. We are handling independent. It would be necessary for every line to have an inspector on the ground to effect the delivery of that car, and it is up to me to demand my own protection. The arbitration decisions all the way through will bear me out. It is up to the receiving line to protect himself with an M. C. B. defect card. One decision says: "Failing to do that you cannot afterwards escape responsibility." The rules provide a way for him to get protection and puts it up to him to get it. As long as he is complying with the rules it is compulsory for me to sustain him in his demands. I have no recourse only to card the car.

Mr. Hodgson: I move you that it is the sense of this meeting that the place to card the cars is at the point of delivery where the delivering line leaves the cars.

Mr. Cox: It is the general practice throughout the country that the car is carded by the receiving line's inspector. I do not believe there is a railroad man in this room who is going to card a car for the receiving line. You are going to issue your card for what the fellow asks for and if he does not get it all, it is up to him. In Toledo our cards are issued for whatever the receiving line asks.

Motion seconded.

Mr. Lynch: I think that was the technical interpretation of that part of the rule which Mr. Pendleton refers to in regard to carding a car as delivered. It does not seem to me that it would be practical, especially where you have joint men looking over the cars both ways at the same point. He is acting in the capacity of the receiving line's inspector on both occasions. In many parts of this country at interchange points, it would be impossible for the delivering line to card a car before they offer it. It would mean two interchange inspections, one before the car is offered in interchange and one at the time the car is offered. It is my opinion that the correct interpretation of the rule should be to card the car at the time and place when it is offered to the receiving company.

President Trapnell: That is the motion as offered by Mr. Hodgson.

Mr. Zachritz: I think Mr. Hodgson's motion is all right. The only practical place to card is at the point of delivery. The manner in which cars will be carded will be determined by local conditions. If you have long hauls between the connections, then you will have to trust the receiving line to do the carding for you. If you have your inspectors working jointly they can make demand at the point of interchange and a man can do the carding.

Mr. Roof: I believe that the delivery tracks, or the receiving tracks, is the place that the car should be carded. We have been delivering interchange in Terre Haute and Evansville along these lines. I put our defect card in the hands of our delivering lines and they put them in the hands of our inspectors.

Mr. Livingston: As I understand this, the cars come in train inspection. They are then broken up and given to the receiving line, and the receiving line maintains his inspector there and the necessary carding is probably done there. Mr. Pendleton states that it will be necessary to move the inspector out there to write out the card for the other fellow. If Mr. Pendleton is the billing road he must have a man on the ground to receive the cars from the other fellow. Then it would not be necessary to have a man on the ground to write out the card for the other fellow. The motion is all right if you drop the word "engine." I think we ought to cover that by saying "track."

Mr. Elliott: He has taken the stand that cars must be carded when offered in interchange. Our reasons for doing this are that we card about 90 per cent of the cars that are carded in the St. Louis Terminal. The duties of carding the cars fall naturally upon the Terminal R. R. Association, and what we want is relief. We are the ones who are bearing the expense. We have had occasions when cars have been pulled away from us and we did not get them carded. We think the cars should be carded when they are offered in interchange. We claim they should be carded when they are deliverd. That relieves us.

Mr. Schultz: If the arbitration committee has ruled on this, all we can discuss is the most feasible way to carry out their rulings. I would like to have this postponed until we can get definite information on the subject. I move you that we lay this matter over until tomorrow morning.

Mr. O'Donnell: I would like to inquire, Mr. Chairman, if we, in interpreting these rules, are on the right track in appealing to the arbitration committee to give us a decision on local matters. They have decided time and again that they will not give any decision on local agreements or local arrangements. The M. C. B. rules are clear. We all know a car is interchanged when it is finally accepted from the line that is going to take it from the other fellow. I think it is simply a matter of delaying our work. We appreciate what Mr. Pendleton wants, but I would tell them without any question that the carding of cars must take place at whatever point is pleasing to the two roads.

President Trapnell: That is practically the motion of Mr. Hodgson. I do not think we are going very far wrong if we adopt the resolution because it is absolutely a fact that we have got to govern the conditions according to the surroundings. If the arbitration committee says we are wrong we are not going to change our methods.

Mr. O'Donnell: The intent of these rules of the Master Car Builders, and they are specific, is that cars should be carded in interchange with missing material, combinations, and such as that. The empty car proposition is simply to haul them along without reading the cards, provided they are safe to run.

Mr. Barker: Empty cars must be received provided they are up to the requirements of Rules 3 and 4 and 32 to 88 inclusive.

Mr. Hodgson: The question is answered by the fact that the receiving road is the judge.

Mr. O'Donnell: I will cite a case. Suppose you give a car to a road that you are connected with, that is unfit for service and requires a new route—suppose you give him a wrecked car. They

reserve the right to reject it, but if there is a local arrangement, they will take the car on defect card. It is optional with the two roads to handle the empty car. They do not compel you to accept them. If it is a draft timber or light repairs the receiving road will accept them; it will go on and you are through with it.

Mr. Head (Wabash): The latter part of that second paragraph reads: "Owners must receive their own cars when offered home for repairs, subject to the provisions of these rules. We have had some little controversy in sending home wrecked cars. We maintain he must take his car without the necessity of asking for home cards, subject to the provisions of these rules providing for the sending home of those cars. It has been our general interpretation of this rule that the owner must receive his own cars, no matter what condition they are in, if properly carded.

Mr. Schultz: I think the interpretation is correct where you have direct delivery with the owner to place the car upon his rails. It then places him in a position to settle in accordance with the rules.

Mr. Barker: The owner says: "I deliver my car to you and you wreck it and give it unfair usage." You are not provided with provisions for repairing the car properly, and the arbitration committee's decision is that it is optional with the owner.

Mr. Kipp: I would like to get the interpretation of this body along that line. I wish to say right here that Mr. Barker and myself have quite a little to do. We handle a good many D. & H. cars and we occasionally wreck a lot of them, and Mr. Barker does not wish to take them back. We settle with him in accordance with the rules. He wants us to put them in a serviceable condition. I would like to know whether I could force Mr. Barker to take the cars.

President Trapnell: Yes, if it is a direct delivery, you can force Mr. Barker to take his cars.

Mr. Zackritz: I invite your attention to Rule 121 in connection with 2 which specifically states the method of getting a car home.

Mr. Barker: I wish the Secretary would read the rule that compels the owner to receive his car in bad condition.

President Trapnell: This has reference to a car on a foreign line?

Mr. Kipp: The case I raised is a D. & H. car.

President Trapnell: You have got to take it. If a D. & H. car was on the Santa Fe, it is necessary for the owner to say whether he wants it to come home that way or not, but if the Santa Fe made direct connections with the D. & H., the D. & H. would have to accept its car.

Mr. Smith. My motion is that it is the sense of this meeting that a car delivered direct to him by a connecting line must be received regardless of its condition, properly carded.

Motion seconded and carried.

Rule 8.

Mr. Barker: I wish to call attention at this time to the fact that there are some roads that do not follow the rules in regard to repair cards and defect cards. They do not print them of the right size and form as provided for in the book of rules, and it makes considerable extra work. I would like to make this as a motion:

That the M. C. B. code of rules having adopted as standards the size, material for, color of ink and form of arrangement of printing for defect, home route, joint evidence, repair, transfer order and bad order return cards. That it be the sense of this convention that these standards should be considered obligatory by the railroads accepting the M. C. B. code.

Seconded and carried.

Rule 9.

Mr. Barker: I desire to offer this as a motion in regard to Rule 9: "The M. C. B. Association having standardized the word yoke as designating the attachment at the rear of couplers as container of springs and followers per plate 23-A. That it is desirable that this word be substituted in M. C. B. code of rules in each place where the word Pocket is used.

Motion seconded and carried.

Rule 14.

Mr. Barker: It is very particular in this rule that the joint evidence shall be in the form provided in the rule. It will save considerable clerical work if we follow the forms and see that the form follows the rule exactly.

President Trapnell: That is covered by your motion to the committee on standards.

Thereupon Mr. Boutet read communications from Cincinnati in regard to next meeting place, and an adjournment was taken until 2 o'clock.

President Trapnell: It has come to my knowledge that some have the idea that if there is anything in the rules that they do not understand that it would be eliminated under our present mode of working. I want to disabuse your mind of that, and any rule that you do not understand, we are at your command to take it up and discuss and arrive at some definite conclusion for all concerned.

Rule 21.

Mr. Barker: Our people are considerably interested in this rule because we have a lot of equipment that is used in Canada, and they are built exactly like stock cars with roofs missing. When the car is loaded it is loaded to the top with the bulk load; when the car is empty, the question is raised that it is not safe for transport on account of no running board, and the receiving road being the judge in that case, it was assumed that they had the right to demand that the delivering line should make it safe. The M. C. B. said the receiving line was not the judge, and the owner was the judge; the receiving road should receive the car and put ladder steps on the inside of the car so that the train men could pass up the ladder on the outside and down the ladder on the inside, being a case where the receiving road was not the judge and the convention took it away from them.

Mr. Gainey: Some years ago we had quite a number of coke rack cars equipped with a running board, but no hand railing. A good many roads equipped with a temporary hand railing, and we objected to paying the bill. The committee decided that the road putting the temporary hand holds on should be paid and decided against us. My understanding is that no company has the right to order a temporary hand railing on coke rack cars.

Mr. Lynch: As I understand Rule 21, any line will have the right to apply temporary hand rails and bills will be rendered against car owners for the cost of applying same. My interpretation would be that any line could apply temporary hand rails on Mr. Gainey's cars after Sept. 1st.

Mr. Zachritz: Wouldn't box or house cars not equipped with running boards be contrary to the United States laws?

Mr. Dyer: The rule is very plain where cars originally equipped with roof or running boards, but it appears to me that inasmuch as stock cars can be put into a condition to haul coke without running boards or roofs, I would suggest that our committee should recommend, if in order to make a recommendation to the arbitration committee to change the rules "when cars are so stenciled."

President Trapnell: The safety appliance law calls for running boards over cars of that character. Where there are sides and ends they have to have running boads for men to go from one car to another.

Mr. Boutet: I move you that it is the sense of this meeting that when any car is equipped with a roof or running board, they can be put on at the expense of the owners. Where it has never been put on that they cannot be equipped at the expense of owners.

Mr. Hitch: I cannot see but that it is very plain just as Mr. Lynch has explained. I would like to have Mr. Boutet amend his motion. We have a number of coke cars that were originally equipped with running boards, but later they are not, and I would like to have it cover cars that were originally equipped but have been removed.

Mr. Boutet: You could overcome that by stenciling the cars, "No running boards."

The motion was seconded by Mr. Hitch. The ballot resulting in 58 in in favor of 9 against.

Rule 32.

Mr. Lynch: The last sentence in that line is something additional to the second paragraph of Rule 3. I would like to know how we are to decide here which to apply. Where it says the receiving line is to be the judge, it conflicts with Rule 3.

Mr. Pendleton: As I understand it, Rule 32 pertains to cars that have been wrecked or damaged. It makes the receiving line the judge. For instance, my car was damaged in a wreck or accident on your line; you delivered it home and I had to spend $150 or $200 to repair the car. It had a metal bolster and complete sand-board. I would not feel like spending $200 to repair the car and turn it loose with the sand board in there. I do not believe there is any man who would repair a car where he had to spend that much money even though the defect did not impair the strength. He would want to renew it and send the car out in proper shape. It allows the delivering line to exercise little judgment in carding a car. Under Rule 3 the delivering line has a perfect right to exercise some judgment. In the other case I would feel that I would not have anything to say.

Mr. Faber: I think there ought to be a limit when the receiving line can be the judge. We had a case a short time ago, four end board bent and the end sill broken up from the bottom about 1½ into an old check. Practically that board could be forced back. He was the judge and he said: "No, I want the car to be end-silled." There was no car man who would have had the car in the shop and given it general repairs, provided it were up to him to stand the expense. I think there should be some limit, so that Rule 3 can be used to some purpose. Some of you think it is all right as long as it is not necessary for repairs, but the other man says: "I want a defect card regardless of whether it is necessary to make the repairs or not." I think we ought to recommend some restriction to be made in that part of the rule, so that there will be some limit.

Mr. Boutet: I cannot see any difference in a car that has been raked and a car that has been wrecked. At all points where there is an arbitrator, he will decide that. We have got to card for what the receiving line demands. If the receiving line says: "I want a card for it," are you going to card it or repair it? Last year we appointed a committee and they designated what to card for, and we got no help from our superior officers. The arbitration committee says: "We will card more instead of carding less." It is not what we think individually, but it is what they tell us to do. In Rule 3 there isn't anything behind it. Who is the judge as to whether they shall be carded or not, the delivering or the receiving line? Is there anybody in the room who won't say that the receiving line is the judge? You have either got to card for it or take it some place else and deliver it. If you deliver it at some other point they will accept it, but it is up to the receiving line to say whether he is going to have it carded or not. Rule 3 hasn't that behind it but your executive committee in recommendations to the rules tried to have that taken up but we could not do it.

Mr. O'Donnell: I fully agree with Mr. Boutet of Cincinnati that the receiving line is the judge, but I think Mr. Boutet and the other gentlemen throughout the country will agree that the bill of the car is a tremendous issue. We could not give $8.00 or $10.00 for a low capacity car that could never be repaired, but the up-to-date car of any class, it is up to the receiving line to demand and receive protection for its own line. I am in sympathy with Mr. Fauber of the New York Central. We have lots of cases that we do not agree on individually, but I think common sense and good judgment should govern. They give us these rules and it is

up to us to interpret them. Do not write out a defect card unless you feel that they are entitled to it, and if not simply say that the car isn't worth the money. That is the way I try to educate my men in the Buffalo district. I do not think we have troubles enough to raise any issue. We must be decent with refrigerator cars.

Mr. Smith: I believe we are getting away from what Mr. Lynch tried to bring out. He contends that there is a conflict there between rule 32 and 3, where rule 32 places the responsibility of damages. It may appear that the last paragraph of rule 3 is superfluous. It simply means that it should not be misused. I think the receiving line is at all times the judge.

Mr. Barker: I want to be one man who says there are cases where the receiving line is not the judge. The wisdom of the association originated joint inspectors, and the joint inspectors came through the arbitrary action of owners. If the receiving lines were not unreasonable the arbitrators and the joint inspectors would all have to go. The arbitration committee and the Master Car Builders are trying to fix it so that owners and receiving lines shall not have everything to say; therefore they added that latter clause to that rule, and the point made is this, if you damage a car by unfair usage, you should make it as good as new, but if it goes through some accident that does not really derail the car, so as to weaken the service of the car, you need not card. I notice that by the Chief Joint Inspectors everywhere the receiving line will say: "You need not give a card for that." That clause was added to that rule so as to make it more explicit in the case of damage of any kind to cars where they suffered unfair usage, derailment or accident. The same damage that occurs through unfair usage, derailment or accident, you should have to give a card for; where if it occurred through ordinary usage, you would not have to give a card for it.

Mr. Zachritz: I think the discussion loses sight of the fact that rule 3 says: "If a car has defects for which the owners are not responsible, the receiving line shall require a defect card to be attached." The owners are not responsible except for unfair usage, derailment or accident, or missing material offered in interchange; consequently the receiving line is the judge.

Mr. Lynch: Rules 3 and 32 are practically the same. As the gentleman who preceded me has remarked, there must be unfair usage when they have authority to issue a defect card, and it is unfair usage that is spoken of in Rule 32. The question might arise: What would constitute unfair usage; that is something I could never tell exactly. The reason I brought this up was I did not know exactly why the receiving line were to be the judge under Rule 32 and it not appear in Rule 3, because without unfair usage we could not issue a defect card. I merely wanted to get the opinion of the association as to the difference in the wording of the two rules that are practically the same.

Mr. Weale: It seems to me that the only question that the Master Car Builders intended to bring out there in Rules 3 and 32, is fair and unfair usage. Even though unfair usage, no defect card shall be used, if it is so slight it does not need repairs. It seems to me it should be perfectly plain that we should only card under unfair usage, under Rule 32.

Mr. Barker: Under that rule, when I damage a car by unfair usage, derailment or accident, I will furnish the owner a blank defect card signed, and he can furnish his own defects. We transport considerable charcoal and there are times when the inside of the car gets damaged by fire. The cars being loaded and the doors closed it is impossible for the inspector to discover it. When we return the car to the owner, he will open the door and discover the inside lining is burned through; would that be considered a concealed part?

Mr. Hewitt (N. Y. C.): In case the inside of a car is burned by acid, can the delivering company bill for charges for putting a floor in the car?

The President: I will say no. The M. C. B. rules cover that.

Mr. Hewitt: Can you charge the owner of the car for putting a floor in that car in order to make it serviceable for transit?

Mr. Whitney: The rule plainly stated, material missing. It is not missing material when burned or damaged by acid.

Mr. Hewitt: Isn't that a delivering company defect?

President Trapnell: I should say no.

Mr. O'Donnell: I do not agree with the president. You take a 40 or 50 ton car and destroy the car, and you will have to work a long time to get them to pay you $15.00 or $20.00 for the floor. These are special cases. Every case that is reported to the superintendent; we do not give any cards at all.

Mr. Barker: We had a case where a car was transporting charcoal and it had damaged the material. The owner insisted that he was the receiving line and that he was the sole judge. He presented his case so clearly to the man that he issued a defect card. I wanted to instruct my men in the proper way.

Mr. Boutet: I move that it is the sense of this meeting that if a car is damaged by acid or fire so it cannot be seen from the outside, that it is owner's defect.

Seconded and carried.

Rule 35.

Voice: What do you consider one damaged draft timber with an end sill or coupler body, a combination or defect?

Mr. O'Donnell: The idea I have is this: Suppose you have two draft timbers and an end sill, what would you do? Our foreman took the stand that that should be one draft timber. I told them that it means timber or timbers. If you have an end sill and two draft timbers charge it to the owners. You haven't a combination to plead. You haven't a coupler or a body.

Mr. Boutet: I move you that it is the sense of this convention that one or two draft timbers and an end sill when not accompanied by damage to the coupler body or pocket, is not a combination of defects.

Motion seconded and carried.

Rule 42.

Mr. Faerber: The owner isn't on the ground but he takes the stand that on account of the coupler missing and the draft timbers being broken, it constitutes a combination and he wants no bill. I take the stand that the end sill should have been removed before the coupler was pulled off.

President Trapnell: All you have to do is to establish the fact that the coupler was not broken.

Mr. Zachritz: We had an arbitration decision covering that point. They had decided that we had a perfect right to repair this car before the combination exists. When you form a combination you become responsible for the sill.

President Trapnell: If we establish the fact that the coupler isn't changed, and as I understand he made the repairs before he allowed the car to go to the owner and the coupler was all right, it still remained owner's responsibility.

Mr. Faerber: We did not charge for any missing material; we charged for the end sill and the draft timber.

Mr. O'Donnell: Mr. Faerber wants this line to be decent enough to acknowledge that the end sill originally was decayed and rotten. Unfortunately the road handling this car East tore the end out and formed a combination. The delivering line could not find the parts missing, so that the line that owns the car are strictly within their rights in asking that you put the car back to its original condition, without any expense to them. There is nothing about it unless the owner says, "Certainly." If they say "No," you had the right to renew the end sill, but you did not do it. Give your card and smile and forget it.

Rule 43.

Mr. Pendleton: I would like to have the association define combination of a steel car.

Mr. Lynch: It is my understanding of that rule that there isn't any combination on a steel car. The words "unfair usage" are used in the rule the same as 32. The third paragraph reads: "When repairs exceed the combinations as covered by Rules 37 to 42, inclusive, owner's authority must be obtained before repairs are made." A combination is not cardable on a steel car because the damage must exceed the combination, and when it does exceed, you have got to go to the owner in order to make the repairs. It is my opinion that there is no combination according to the rule on all steel, or steel underframe cars. I do not know what is meant by the term "unfair usage" on steel cars. It might be derailment or corners, or something of that kind, but as to the end of the car bending down from ordinary wear and tear, I do not think there is a combination formed.

Mr. Pendleton: Under the first paragraph of Rule 43 the delivering company is responsible. We all understand that derailment or the corner of a car is unfair usage. We also understand that a combination of defects is unfair usage. To my mind there is a combination on a steel car and the Master Car Builders intended the same. Rules 37 and 42 cover the same as in a wooden car. But if it were an old car, and we know that the old ones are corroded and weakened—should one of these cars be on a foreign line, I would consider under the rules that that formed a combination, but it was not due to unfair usage; it was due to the corroded condition of the car, and before the line on whose line the damage occurred could make any repair, it would be necessary to take it up with the owner. With a new car it would have to be unfair usage and naturally he would not get authority to make repairs in that case. I feel that Rule 43 covers the combination of a steel car the same as on the wooden, except when in a corroded condition; authority of the owner should be granted and the repairs made at their expense.

Mr. Lynch: I would like to call attention to the fact that there is a very great distinction between the terms unfair usage, derailment or accident. In the 32 that distinction is made. It says damage of any kind.

Mr. Boutet: I would say if I had an end sill that was damaged between the coupler and the outside, evidently having been struck by something, I would give a card for it. In answer to Mr. Pendleton, if I had an end sill that was damaged between the sides and gave evidence of having been struck, I would give a card for it. If I had a car with two end sills broken I would refuse to give a card for it, even including one end sill and two draw sills. I am glad this question came up.

Mr. Pendleton: If an end sill and two draft timbers are broken, would you take into consideration whether the car was corroded or not?

Mr. Boutet: Yes sir, whether the car was corroded or not. If the car had been damaged in service, in coupling to another car, they broke the end sill and two draw sills, I would not consider it a combination.

Mr. Pendleton: Combination of damage to cars with wooden underframes. Doesn't that apply to the steel car the same as the wooden car?

Mr. Boutet: If the end sill showed that it had been struck, I would consider it unfair. If the end sill was damaged and it damaged two other sills, I would give a card for all of it. But if the car had been damaged from coupling the car, and the two couplers came together, I would not give a card.

Mr. Pendleton: In case of a wooden car, the question was raised: If you have two draft sills broken in a wooden car and there was nothing to indicate that it happened in any other way only striking the coupler, would you card it as a combination of defect?

Mr. Boutet: Yes, but I would not card the steel car.

Mr. Stoll: I have to disagree with Mr. Boutet. Railway com-

panies are running cars through the shop and repainting them and do not repair the damage. The M. C. B. rule says when the repairs are necessary.

Mr. Boutet: I presume that he considered the damage was enough to require repairs.

Mr. Elliott: I am going to explain why I claim they did not mean the same combination to apply to the steel car that they did to the wooden car. Any of you practical men know that a steel car has failed under ordinary wear and tear, not only due to corrosion but due to sills bending out and damaging the end sill. If Mr. Pendleton's argument is good, why did they make a distinction between the steel car and the wooden car? Why didn't they let the wooden car combination govern the steel car?

Mr. Cox: I want to agree with Mr. Stoll. It is a fact that the end sills bend out 6 or 7 inches and as long as they do not interfere with the sills, I do not understand why you have got to card for them. My understanding is that we are not to card for any parts unless they are going to be repaired.

Mr. O'Donnell: The argument as originally brought out by me was on repairs; not on corrosive cars. These are up-to-date cars with the heavy flange. Speaking on the question of combination, we all appreciate the fact that if we strike a wooden end sill the same as a metal one, under the same conditions, it is shattered. Where is the difference between the metal end sill? It is due to unfair usage. We have to destroy it and the wooden one is destroyed.

Mr. Barker: If the card is given and the repairs are not made, there isn't anybody suffering any damage, because if the card is given and you do not make the repairs you do not bill.

In regard to damage to cars with all steel underframe, we have it from high authority that it was not intended that a combination as mentioned in the other rules, should govern, and all steel cars and all steel underframe cars with 8 and 10-inch channels, we are billing for them. The strength of the channel is bored away by the rivet hole. We put them in the head end of the train and pull them on. The owner says: "Give me a defect card." If you damage one sill and a combination does not enter into it. We do not have any trouble billing for all steel underframe cars that have 12 or 15-inch channel. As I read the discussion of the Arbitration Committee and the Master Car Builders, they are not settled in their own minds, and they left it to the Chief Joint Car Inspectors to decide largely as to what shall form a combination, and they will arrive at it from their decision.

Mr. Barker: Shall this convention say from their experience in the handling of steel underframe, or all steel cars, that the items in the combination for that class of cars, should exceed in number the items as given in forming a combination on wooden cars?

Mr. Zachritz: I think if the gentleman will refer to Rules 37 and 42 he will see that steel or metal underframe cars are included in this.

Mr. Boutet: I hope this association will not attempt to say to the master car builders and superintendents of motive power, what shall be considered as a combination of defects. That is a body of men who are over us, and it would be a little far fetched.

Mr. Dyer: I move that it is the sense of this meeting that a bent metal end sill, where it is not necessary to send the car to the shop for repairs, shall not be considered a cardable defect in interchange when the car becomes empty.

President Trapnell: We will suppose you were receiving a car in the West and the home was in the East; it had to go over several connections, and the car was delivered to you, and you allowed it to pass over. Would you refuse a card because the car was not going to your shop?

Mr. Dyer: If it is necessary to send the car to the shop when it gets to its home line, it is necessary to send it to the shop when it is received.

Mr. Boutet: If a car passed me in interchange between two foreign lines, unless it were necessary to repair that car, the car should not be carded for an end sill.

Mr. Dyer: Where it is not necessary to send the car to the shop, I cannot see any reason why the district passing the cars should have a defect card.

Mr. Boutet: It is impossible for us all to understand it alike. If we put a card on, we find a good many that are unnecessary. There are quite a number of cars running around over the country with slight defects, but if we give instructions to our inspectors that it must not be carded for that end sill, I think we are following the instructions that are given to the majority of us that we must live up to M. C. B. rules.

Mr. Cox: You are not to card for anything unless it is being repaired. The end sill is left in for six or seven weeks and they do not repair it; the card does not help the car at all and it should not be carded.

Mr. Gainey: Rule 32 covers that. The receiving line is the judge in all cases.

The question was put upon the motion and the motion lost.

Rule 58.

Mr. Zachritz: I would suggest that it be the sense of this meeting that the members of this association take up with the different railway clubs and car foremen, and the different organizations they come in contact with, to petition the Master Car Builders' Association to not give us another deal like they did on the air hose proposition. We passed through that and we know what it is.

Mr. O'Donnell: I would like to find out how many cars are carded in Cincinnati now for non M. C. B. standard hose.

Mr. Boutet: I do not keep track of the air hose. In my opinion it would run to eight or nine hundred cards a month.

Mr. O'Donnell: That is close on to a thousand. We do not card over 100 in Buffalo. I think that ought to be car owner's defect. It is criminal to take $1.20 out of the delivering line and that is what you are doing when you card for it. I think we ought to eliminate as far as possible carding for imaginary defects.

Mr. Boutet: You should not censure me altogether. Different roads there insist upon an M. C. B. defect card, some points where they are carding for air hose. I cannot see everything the inspectors card, but every time they take it up they ask why it hadn't an M. C. B. card, it does not have the proper label on. The cars are in the hands of the receiving line, and I have no doubt many of them are carded that ought not to be, and then there are lots of cards put on and the cards disappear, and there is nothing to do but to card for it. If a car comes along with an air hose that is not an M. C. B. standard, we have to card. Possibly the reason they do not card many is because we have to card for them all.

Mr. O'Donnell: We compel the receiving line to change the hose. It is wrong to put on a card for air hose.

Mr. Boutet: I have no doubt it would save a good many cards, but if I attempted to tell one road "You cannot card for an air hose. If it is wrong, take it off," I think they would hang me.

Mr. Stark: In regard to the new label, it means a lot of expense after Sept. 19, due to the fact that the delivering line is responsible. We had this matter up for discussion and it is quite plain why we ought to vote in favor of it. It means a big expense to the railroad companies if it goes through.

Rule 64.

Mr. Boutet: The one important thing in there is nuts. At the M. C. B. Association meeting, the people who had been running cars the same as Cincinnati were severely censured. There was quite a number who insisted on the defect card being put on.

Mr. Lynch: We have sent them to the repair track with a side door missing; not because it had a defect card on, but because the defect existed.

Mr. Boutet: Rule 64 says that every nut that is missing on the trucks is a cardable defect. The only exception is oil box lids. Let us get the correct interpretation of the rules. Possibly I am wrong, but it is pretty well understood that every car that is offered in interchange with a missing nut on trucks is a cardable defect, and I make that as a motion.

Seconded by many.

Mr. Lynch: I agree with Mr. Boutet according to the rule, but I think the intention there is that the repairs shall be made. In reference to applying the card, it is to compel him to make the repairs if possible. He does not always do it.

Mr. Zachritz: The stand that Mr. Boutet has taken in regard to this matter is the correct one. The Master Car Builders, as I understand it, have eliminated nuts from the exception for the reason that they want you to repair them. They are just as small an item to put in the rules for the bodies as they are for the trucks. We can agree among ourselves to ignore the rules and they cannot penalize us for it, but I do not think this association should go on record as trying to change the rules. We should accept them as written and interpret them as written.

The vote resulted in 69 for and 34 against, and the motion was declared carried.

Rule 66.

Mr. Zachritz: The Soo Line, if this rule is carried out, will be in as bad fix as we were when we run up against the air hose proposition. We have a large number of cars equipped with a composite double plate brake beam. Some of them have been in service since 1887, and we have yet to find one of these brake beams which has failed under fair usage. We use them only on the lighter capacity cars, and I will say that they have given perfect satisfaction in every way, and our company does not feel as though it should be required between now and Sept. 1, 1915, to throw away all the material in the scrap pile. We will take it very kindly if the members of the Association will, through the different railway clubs, car foremen's associations, etc., recommend the elimination of this paragraph for the reason that it is a rule that is not going to do anybody any good, and is going to cause a lot of money to be deliberately thrown away.

Mr. Zachritz: Some years ago I was on a committee on the subject of brake beams, and through the North-Western Railway Club we applied a test of that beam. It complied in every respect with the Master Car Builders' test. We find it today better than any of the metal brake beams that are in use on that same class of cars.

Mr. Roof: I wish to state that I do not think it would be diplomacy. Railroads all over this country have been throwing away the wooden brake beam on account of them not meeting the requirements.

Mr. Zachritz: We are not asking in 1915 to accept something of an inferior nature. We are offering you a better beam than you have on your cars when you have an all-metal beam. We have made a test and found this beam better than an all-metal beam, and I have never known one of these beams to fail under fair usage. Of course you can break them by striking with a pilot, or when you have an accident, but not with fair usage. That I can say because we are charged up with a good many metal beams on cars of that same class.

Mr. Dyre: The brake beams on his road may stand up the test, but the object of this rule is to do away with all wooden beams that would not stand the test. Why make an exception on account of his road being equipped with that beam?

President Trapnell: Referring back to Rule 67, I want to ask how that affects nuts on trucks that lose off under ordinary wear and tear of the car.

Mr. Pendleton: I understand Rule 67 simply defines owner's responsibility; to be applied and charged to the owner.

Mr. Barker: We passed a motion that all nuts are delivering company defects and if not repaired they should be carded. I voted "No" on that on account of this very rule, and the only question about that is "not elsewhere provided for."

Mr. Zorin: The rules are very plain. Rule 64 says "in interchange."

Rule 101.

Mr. Schultz: It is all office work, and has no reference to labor.

Mr. Zachritz: The balance of the rules simply deal with billing, and I think it safe to pass them over. I move you that we pass over the rules and if there is any party who wants to go back over any of the rules, we can take it up at some other time.

Motion seconded and carried.

Wednesday Morning.

President Trapnell called the meeting to order at 9 o'clock.

Mr. Boutet requested all chief joint inspectors to retire with him in order to draft a resolution to come before the meeting.

Report of Committee in Revision of Constitution.

Mr. Schultz: Your committee to revise the constitution to provide for two vice presidents have canvassed the situation and from what can be learned from the individual members and in going over the matter at this time, find that it is not consistent to provide for two vice presidents. In these days of rapid promotion, they get out of line so quickly and perhaps a good man would be in line that we would have to embarrass later; so we feel that no condition has arisen which would make a second vice president necessary, and your committee therefore asks for further instructions.

Mr. O'Donnell: I move that the committee's report be accepted and the committee dismissed with the thanks of this association. Seconded and carried.

President Trapnell: I would like to have the report of the Secretary-Treasurer.

Secretary Skidmore read his report for the year ending Aug. 26, 1912, as follows:

Receipts	$947.86
Disbursements	771.93
On Hand	$175.93

Mr. Boutet: I move that the report of the Secretary be received and spread upon the minutes.

Seconded and carried.

Secretary Skidmore read communications from St. Louis.

President Trapnell: These will take the same course as the invitations from Cincinnati and will be handled in the same manner.

The following letter from Mrs. Grace M. Stark was read by Secretary Skidmore:

To the Officers and Members of Chief Interchange Inspectors and Car Foremen's Association: We wish to extend to you our sincere thanks for the beautiful flowers sent at the death of our dear husband and father; also to Mr. Boutet and Mr. Skidmore for their presence at services and their kind words of sympathy.

In sorrow,

Grace M. Stark and Sons.

President Trapnell: This letter will be spread upon the records of this association.

Mr. O'Donnell: We have a lot of trouble down in our districts with bad loads. Our executive committee thought it would be well to secure figures of the condition of these cars at the doorway, as they came from the west. We have distributed a number of these to the operating officials, and our executive committee, through Mr. Thompson, thought it would be wise to make a lot of these books, and I would ask your permission to pass this little book around.

President Trapnell: He has photographs of the different kinds of cars, and I see he has some from the part of the country that I came from. He has not picked out any section of the country, but it is from the East and West, North and South. It will be information for every one, and when he desires, we can take some action. I will now turn the chair over to Vice President Stark.

Mr. Stark: It was decided at a previous meeting that if any member wanted any particular rule discussed, it might be brought up at this time.

Mr. Zachritz: I would like a little information on the rules governing the repair and carding of wheels, 68 to 86 inclusive. Last year we were required to use the same defects as enumerated in these rules, also required to state the variation from these dimensions. I notice they have cut out the clause where you have to state the size of the defects, and during the current year it will be unnecessary to state the size of the worn through chilled spots, as per rule 68 to 86.

Mr. Kipp: I think Rule 10, page 14, fully explains that.

Mr. Zachritz: The explanation is not satisfactory. In addition to that last year we had to give the size on the repair card. We had to give the specification. For instance, if a wheel had a seam 3 inches long or more, we had to state the length of that seam on the repair card. That has been eliminated this year.

Mr. Kipp: That was so in last year's rules. We were obliged to give the prescribed limits, but this year they dropped that so we did not have to give these verifications, only as they are prescribed in Rules 68 to 86.

Mr. Pendleton: It seems to me that there are several rules we can touch upon. I desire some information regarding Rule 15. We are all interested in the transfer proposition, especially at outside points where we have no outside inspector.

I understood that A. R. A. Rule 15 had been revised and they had provided for a 24 hour labor clause. The rule is printed on 108 and the revision is not shown. I would like to know if the rule has been revised. I know it was recommended by the A. R. A., but I am not positive whether it was passed or not.

Mr. Wymer: I happen to know that the committee that was appointed to rewrite that rule has made a report to the effect that there would be a 24 hour clause, and that report was received by the Association and laid on the table for further consideration. No final action was taken.

Mr. Hyman: Mr. Pendleton in bringing up that rule 100, A. R. A. 15, I notice in this book that they have given a form to fill out, card to be transmitted under A. R. A. Rule 15. I am not a car inspector, but I am a chief clerk and I get the billing end of this proposition. I would like to have some instructions: This card will be given to you by the delivering line and the receiving line has authority to transfer that car. We have propositions on belt roads, not only ours but others for the same purpose. We haul cars short distances many times. We receive a car from the St. Paul or the C. & N. W. with defects on that car which would necessitate the transfer of that car, and which would be properly transferable under A. R. A. 15, but when we bring them into the shop for transfer, the car might be safe; we are up to the next connecting line, perhaps the Santa Fe, as the case may be; it is only a step across to deliver it to the Michigan Central. We get authority from the E. J. & E. for a transfer to bill them. They would be the delivering line. E. J. & E. may pay the transfer to the Michigan Central. They actually make the transfer. I have the permission of the St. Paul and N. W. where it came on our line to make the transfer. Would I be permitted to offset the bill, or turn around and make the same charge against the line we received the car from?

Mr. Zachritz: I would say that under the circumstances that matter could be handled in the same way that a great many repairs made on cars that are not on your line are handled. The dead movement train, the line transferring, could make a statement on the face of the card transfer for the intermediate line. We have a great many repair cards where they make a statement on the repair card that the repairs were made for the line, as the case may be. In some places they are doing this.

Mr. Pendleton: It seems to me there would be no end to that if that practice were allowed. I would say: "Let the car go on." If the Rock Island transferred against me I would send him this card. I am like the man who said he was a chief clerk. As I understand the transfer proposition, at the outside point where this card was granted, it would be turned over to the agent. The transfer proposition is a transportation matter.

Mr. Hyman: This card, to my mind, would act something on the same plan as a defect card. You take a card on the line of the missing side door. It was what we call a rebuttal card. If I have authority from the C. & N. W. to bill that car and we transfer it, we have authority to bill the other fellow, and I do not see why we could not use it.

Chairman Stark: There is no reason why you could not use it. If you could pass it on to the first or second fellow there would be no end to it.

Mr. Zachritz: If we do not have the facilities for doing the work, we could let the other fellow do it and pass on the card.

Mr. Hyman: In this new book of rules they have made a form of a card to be used in duplicate, and to be used for cars transferred under A. R. A. Rule 15. If I should hand you over a car and find it is not safe to go a long distance, or perhaps you have a trunk line road, and it has defects on there for which you would be entitled to transfer the car under A. R. A. Rule 15. You have this form made in duplicate, the delivery line gives the other line permission on this card to make this transfer. The duplicate must accompany the bill for the transfer. We receive the car from another line and it has the same defects. We ask this connecting line for authority to transfer this car and charge that delivering line. We have no facilities for transferring the car, or, we bring it to my terminal and it is going to any one of these roads, which may happen to be Joliet. After it gets that far the car is safe enough to be handled further, and we turn it over to some other road there. They in turn come back for permission to transfer the car. They transfer the car and bill us. The point I raised is can we take the authority from the C. & N. W. and offset that bill against that road for the transfer of that car?

Mr. Wymer: The point raised by the gentleman has considerable merit, and it is one which has given considerable concern in Chicago. A special committee was appointed by the executive committee on Interchange Bureau to investigate the matter and make report as to how it could be properly handled. That committee did make a report and recommend that a transfer order will be given by the Inspection Bureau of Chicago, and that if the car had been received from the connecting line by a switching road with defects which the outgoing trunk line saw fit to transfer, that the transfer order should be issued back against the delivering trunk line. The matter has not been finally adopted or approved.

Mr. Livingston: I cannot see where there would be any question in handling cars that way from one railroad to a switching road, and the switching road to the other fellow. When you get the car from the first man and get his authority to transfer the car, you have his authority. He does not say who is to do the transferring, and it is optional whether you do it or somebody else. If you cannot do it, you can say that samebody else can do it. You can bill the other man for the expense and he transfers it for you. You already have authority, and you can counterbill. There is nothing to stop you. He does not say you have actually got to transfer the car, whether you have facilities or not. You can take it and have some private individual transfer

it, and whatever the expense is the other fellow is willing to pay.

Chairman Stark: It would have to be a special agreement. Under A. R. A. rule you can make a special agreement, but I am of the opinion it is contrary to M. C. B. rules. However, it can be handled under a special agreement.

Mr. Barker: Does the form of transfer card possess the same value in billing on a road as the M. C. B.? From the form described, it does not. It has been handled by the mechanical department, but the operating department has taken hold of it now, and these cards are for their benefit entirely, and the easiest way is to obtain consent of the line that issues the card to accept the bill, and as it has been mentioned, it could be arranged locally in that way. But from the form of the card, it will not possess the same value as a defect card.

Mr. Forest: In my opinion when the railway gives this car to a switching line, and it was damaged, not so much that it requires immediate transfer, the switching line should make a report of the defects existing on that car and pass it on to the receiving line. If the receiving line sees fit to transfer the car, they are then furnished with a transfer order by the Chief Joint Car Inspector against the line that offered it to the switching road. However, the cost of transfer is put back on the railroad, providing the switching line does not damage the car to such an extent while on its line that it requires transfer before delivering to the receiving line.

Mr. Wymer: That is the only fair way the matter could be handled. The switching line is not in a position to know what the trunk line is willing to put on it. There is a variation of efficiency required on different roads, and a switching line cannot very conveniently anticipate what demands the other road will make, and if the switching line were forced to demand transfer orders in anticipation of what the other roads require. It seems to me it might work a hardship on the delivering trunk lines.

Mr. Livingston: I cannot see why this man could not have somebody else do the transferring. The switching road gets his authority from the road that delivers the car for the transfer or the lading adjustment, and it is issued to the belt road. That is all he says about it. He does not say that you shall not give it to somebody else. There is no question but that he knew the road could not transfer it. If the switching road takes it some place and has somebody adjust the load, he has authority to bill the other fellow for what it costs. If he says you must do the labor individually, that is a different proposition. All you want is authority to bill him and you have got that.

Mr. Roof: The man who just spoke, views the subject from rather a broad angle. The rules will permit any railroad company to either hire or transfer the contents, but to handle the car and deliver it to another connecting line is a different proposition. If they see fit to run the car down to some factory and have it transferred they can bill, but if they run the car to some other railroad they assume the responsibility and give up their rights.

Mr. Hyman: I move that it is the sense of this body that an intermediate road or switching line, when they have an order from a delivering line to transfer a car, that if they pass this car to the next line and give their transfer order, and the car is transferred, that the intermediate road has the authority to bill the original delivering line on their authority for the transfer, or the expense of this transfer.

Motion seconded.

Mr. Zachritz: I do not think that is a fair proposition. You cannot bill on the authority that you receive. You could pass that same authority on and allow that railroad to bill as per your road. I think you could make that stick, but I do not believe you could use the offset authority and bill.

Mr. Bradley: If it is a switching road they will take care of his wants and see that he gets what is needed. The chief inspector will issue an order to me and not him. It would not be necessary, if we pass this motion and authorized the man to bill on rebuttal.

Mr. Wymer: Our president expressed the idea that the switching road received the car from a trunk line and passed it on to another car line, the switching line would be responsible.

President Trapnell: I said if they got the transfer order. If they assume the right of the transfer order, it is up to them to transfer. If the chief inspector were called in, he would make it against the proper party, but they must bill on that transfer order themselves if they undertake it.

Mr. Wymer: I would rather see it amended that the transfer order be issued back against the road that delivered the car to the switching line, if the record showed that they were responsible for the car.

Mr. Hyman: We are in Mr. Schultz's district; he has assistants and they have a certain district to oversee. We are taking as a rule receiving line's inspection regardless of calling on one of the assistants from Mr. Schultz's office. There isn't a man on this particular ground to see this car unless it would be held and he would have to be advised by correspondence, which would delay the car. We turn it over to the C. & A. and Mr. Pendleton says it was so, and we know it was a fact because our inspector got the card in the same condition. We have no joint inspector. We have our own man and the other roads have theirs as the small points also the terminal.

Mr. Trapnell: If you do not make a demand for the order of the transfer, but pass on your record, the other fellow is responsible.

Mr. Hyman: Our inspector will take this car from the other roads and he will show him to his satisfaction. If you have to transfer that car, the records will so show. We took the car down and delivered to this line and they did transfer it and billed us for the transfer. I in turn billed on our record when we received it, and the records of both inspectors will show that the car was in that condition, and they turned the bill down. This form of order must be used, and when I get that form of order, I claim it is authority to bill that company; it doesn't make any difference who made the transfer.

Mr. Pendleton: If we have a car from the Milwaukee, and deliver it to the C. N. W. and made a demand for a transfer, it would be handled from Mr. Schultz's office. The assistant chief inspector will make that demand on him. If the records are all right, he will issue an order on me and you will know nothing about it. There is no occasion for any delay, as long as your record protects you. If an order is issued against you, you will immediately get busy and look up your record. If you find it is O. K. you can readily see that the chief inspector was justified.

Mr. Wymer: Under the constitution and by-laws of the Chicago Interchange Bureau all inspectors are joint men and come under Mr. Schultz's authority, as far as interchange matters are concerned, and I would like to amend that motion, that it is the sense of this meeting that if the load requiring transfer originates on a switching line that the transfer order should be issued against the switching line; but should the out-bound carrier find it necessary to transfer the load delivered to a switching line by an in-bound transfer, for defects which require a transfer, that the order should be issued against the in-bound carrier.

Mr. Pendleton: I feel that our chief inspector is capable of handling this under the rules, and I would not like to dictate to him.

Mr. Livingston: I do not believe he carried in that the record of the switching line. Since we have found out there is a chief joint inspector having jurisdiction over this territory, Mr. Pendleton's suggestion is very plain. You cannot get past it. If the switching line gets a record and the other fellow gets the order, he has got to protect him.

Mr. Head: We are all getting away from our friend's idea. He is not asking for anything for what we have been doing in the past, but this card has come up and he asks for authority for the rebuttal. We are all opposed to rebuttals. He asks authority to rebut the bill against him by the receiving line. I never can see the justice of any road trying to escape responsibility through some intermediate line. He assumes the responsibility when he gives the card for the transfer; it hardly seems possible he should dictate who should do the transferring. But in this case the car runs as he brings it out in the Chicago territory; taken out twelve or fifteen miles in another territory. The question will come up, was the transfer necessary? It will create correspondence. I believe he should not be allowed any opportunity on a rebuttal charge.

Mr. Livingston: That brings up another point. You have only got the car inspector to depend on. You have got to take his record. The switching road cannot slip out of anything. If he has a record, he will get an off-set. He cannot pass it over to the other fellow if he has that record. If the other fellow transfers against you, you have protection. He will say: "I would like to have rebuttal." The inspector has the same record. Isn't that absolute proof?

Mr. Schultz: I just came in and do not know the drift of the discussion. Inasmuch as the switching road handles cars on a small charge, they cannot afford to provide ways and means to transfer bad order cars coming off of trunk lines that have been hauled for a long distance. On the other hand, they can afford to handle the car and earn their revenue. I do not feel that an attempt should be made at the point where the load is tendered the switching line to get a transfer order. I feel that the responsibility for transfer of switching lines should be confined to cars loaded on their rails, or damages on their rails. For that reason I feel that if a car is tendered to a switching line with damage, being safe to move, and the damage is sufficient to compel the trunk line to transfer the car, and in that case, where the switching line does additional damage, they alone should not be held responsible, but the charge of transfer fall back upon the originating line.

Chairman Stark: I am going to assume the authority of putting it this way: A motion to the effect that when he received a switching order and transfer order, after having asked for it, I am going to ask you to vote "Yes" or "No." And later we will present the matter that he simply received the car from the delivering road, makes proper record of the defects, passes it on to the receiving road. The receiving road gets a transfer order, can the receiving road bill the trunk line? All in favor of the motion that he ask for and receive a transfer order as to whether or not he can pass that on to the receiving trunk line, the receiving line to have authority to bill the delivering trunk line.

Mr. Head: The gentleman asked for authority to counter-bill. That is not transferring the original order that he received over to the other fellow.

Mr. Hyman: I asked if I did not have a perfect right when the other line billed me for $2.75 for transferring a car, to go back and turn the bill over to him.

Mr. O'Donnell: We have the same thing in Buffalo, and in order to overcome the backward movement of the load, the trunk line says: "It is up to you." If the car originates on a switching line, we have a record.

The question was put upon the amendment as made by Mr. Wymer and carried.

Mr. Barker: I want to submit a motion on A. R. A. rules: That the placards required by paragraphs 1665 and 1666 and 1940 of Section 3, and as illustrated between paragraphs 1666 and 1667 should have printed upon them the directions for attaching on sides and ends of cars the regulation distance from the floor of car, which is 4½ feet. We have had a great many delays to loaded cars under this A. R. A. rule because the placards have

not been at the proper distance of 4½ feet or more from the floor of the car. In my conversation with the men who place the placards on, they say: "Why don't the R. R. companies tell the men where they want the cards put." It appeared to me that it would eliminate delays at interchange points if the directions were printed on the placards.

President Trapnell: I believe the R. R. Association has furnished pamphlets to every one. If the gentleman feels that he is the only one qualified to interpret the same, he should be held responsible for the delay to the load. It is intended that these pamphlets should be in the hands of every one. I believe it would be unnecessary to place any more printing on the cards.

Mr. Barker: The Interstate Commerce Inspector told me that the way they arrived at 4½ feet as the distance from the car floor was that in the state of Ohio the explosive card was found on the side of a car on a side track a short distance from the station. Some boys were practicing rifle shooting and were using it as a target. They fired into it and destroyed seven cars.

Mr. Boutet: If this association were to attempt to get on its proceedings everything that pertains to what some other department of the railroads are looking after, we would stay here some time. The American Association of Railroad Officers has appointed a committee on the transfer of explosives, and if we attempt to define the duties of that committee we will be sat down on. If we confine ourselves to our own work we will be doing all we can.

President Trapnell: I do not think this resolution would be in any way defining their duties or dictating to them. The roustabouts are not in a position to know of this information because it is not handed down to them.

The question was put and the motion carried.

Mr. Boutet: A meeting was called of the chief interchange inspectors at the large points in the country and we drafted a resolution to be presented to this meeting. I will ask Mr. O'Donnell to read it.

Resolution.

The convention of the Chief Interchange Inspectors and Car Foremen in session, realizing the importance of overcoming as far as possible consistent with safety, all unnecessary delay to the handling of freight at interchange points, and inasmuch as there is a large diversity of opinion as to the real meaning of the rule covering damages so slight that does not require repairs in so far as the requiring defect cards are concerned, do respectfully petition your honorable body for the real reason and intent for this particular rule being adopted as a portion of the M. C. B. rules, and a general idea as to the benefits to be derived from same, with a view of arriving at information at all points on the particular rule.

T. J. O'Donnell,
Charles Bossert,
W. J. Stoll,
H. Boutet,
W. D. Isgrig,
E. R. Campbell,
F. T. Rice,
C. M. Costley,
Arthur Denne,
Albert M. Patrick,
A. Singer,
J. E. Vittem,
George Lynch,
F. W. Trapnell.

Mr. Boutet: I move you that the report of the committee be concurred in and a copy of it be sent to the arbitration committee, and that will bring forth a reason for them to explain Rule 3 a little better. I think you all realize the difficulty in defining what we should card for, and this body of interchange inspectors was unable to agree among ourselves what we should card, or how we were going to keep our inspectors from carding and we will probably get an answer from the arbitration committee defining what we want to know.

Mr. Wymer: I am very much in favor of this motion, and I think the arbitration committee will recognize the opportunity for a difference of opinion. And from the different expressions from this body, I am sure they will welcome an opportunity of getting a satisfactory explanation as to what is needed.

Mr. Boutet: I am free to admit that there is one joint inspector who does not claim to know it all. A man like Mr. Barker will come along and find that the paint has been scratched and he will insist upon a defect card. Another foreman who wants to be fair and liberal will say he does not care for anything for it. It is just such opinions as those that keep the joint inspectors at sea. All you people who are car foremen have charge, directly or indirectly, over your joint inspectors. There are no two car foremen who will agree on Rule 3 and say what shall be carded, and it is up to the inspector to say what shall be carded. At the large interchange points there is no individual man can show them. He tries to get instructions to the men but the rule is so misleading. The joint inspectors over the country are possibly a little bit dull, but we have a large number of ministers in the country who claim to be very smart, and there are no two of them who will take the same verse in the Bible and preach the same sermon from it; I do not know what you may think of a dumb interchange car inspector. We have put this up to the arbitration committee with a view of getting them to express something that will be plain to all of us.

Mr. Boutet: Two years ago this association passed a resolution as to what we would card and what should not be carded. We tried to be plain and tried to be fair, but we were sat down on most beautifully and that resolution was ignored. When we are not allowed to interpret them, let us get them to interpret them and tell us what they want.

Mr. Faerber: Each and every one of us would like to have a correct interpretation of Rule 3. I might consider it plain, but another man would say: "No, I want a card." We have private lines to deal with, and I think it is a good thing to get a ruling on it.

President Trapnell: We are not all college bred by any means. We are all human and liable to err. Not willingly, but we give our decisions from the best of our knowedge and belief in interpreting the rules. I certainly do not think it reflects anything upon this association to have the Chief Interchange Inspectors and Car Foremen ask that honorable body to interpret that rule. M. C. B. Rule 32 is sprung upon us and says it is identical with this rule.

The question was put upon the motion and carried unanimously.

Mr. Elliott: A side sill spliced. Rule 107 says we are allowed to charge fourteen hours' for one side sill spliced. Over in another part of the rule it says: "Each side or intermediate sill spliced, when longitudinal sills have to be renewed or when other sills are spliced at same end, eight hours." If you charge fourteen hours for one side sill, suppose you had two side sills to splice, what would you charge?

Mr. Harvey: I do not think there would be any question about nineteen hours for one side sill.

Mr. Gainey: I cannot agree with Mr. Harvey for the reason that when the price lists of labor are made up on a car the time it takes to take the body bolster down and the draft timbers down and all work pertaining to that class of work is taken into consideration. Where one side sill is spliced on a side of the car you do not take down any of the other work. You simply take it down and splice it, and you do the same on another end. To my way of looking at it twenty-eight hours would be the proper charge.

Mr. Elliott: In case of renewed sills it would be different because you would have the body bolster down. Where in case of the side sill spliced you would not have to take it down; but if you had two, you would have to drop it all down, loosen the end sill; consequently you would have twice as much work as you would have with one.

Mr. Harvey: According to his remarks, it would be fifty-eight hours, but the rule says fifty hours. We take into consideration the fact that you have done part of the work in renewing the sill and the same would apply in splices.

Mr. Gainey: In putting in the two side sills it is impossible to get at it unless he backs his end sills out. In splicing the side sill you do not have to back it out. You can take it out without renewing the end sill.

Mr. Roof: I am of the opinion that a twenty-eight hours' charge would not be unreasonable, yet in the face of the rule a nineteen hours' charge is all we could charge for. While the price may be under, it equalizes itself. If we repair a foreign car at a greater cost, we make good when our cars are repaired on foreign lines. I believe a correct interpretation is nineteen hours.

Mr. Barker: The splicing of two side sills is an independent proposition, and unless we could show that there was an overlapping labor charge, it would be fourteen hours for each item, and to reduce that charge, if a road were inclined to refuse to pay, we would be obliged to show that there was no overlapping labor charge.

Mr. Harvey: I do not think there is enough in it to spend the time on it. Put it up to the arbitration committee.

Mr. Boutet: I am certainly surprised to see you lay down so easy. I cannot help thinking that Mr. Gainey and Mr. Elliott are right. If a side sill is spliced you are allowed fourteen hours. If an adjacent sill is spliced, it is a different operation. A side sill on one side of a car spliced and a side sill on the other side of the car spliced, there is no overlapping of work, and a charge of fourteen hours for each sill would be correct.

Mr. Elliott: I move you that it is the sense of this meeting that where two side sills are spliced on the same end of a car at the same time, and no other repairs to sills are made, that a labor charge of fourteen hours be made.

Motion carried.

Mr. Elliott: In regard to the truss rod. Do you consider that to mean one section of the rod or the entire rod?

Mr. Bradley: That means the body bolster truss rod.

Mr. Linder: We had occasion a short time ago to turn off a pair of wheels on a foreign car on authority of a defect card, due to not having new wheels to apply. How would you present a bill for that work?

Question: What were the defects on the wheels?

Answer: Slid flat wheels, on authority of a defect card.

Mr. O'Donnell: I charge the actual time and labor and the material. There is a special case.

Mr. Boutet: It appears to me that that rule is plain. If a man received a D. L. & W. car from the C. H. & D. and gets the car from the Big Four, the Big Four gives a defect card for one pair of cast steel wheels slid flat. He would charge the Big Four for turning up of that metal, give the owner a card for loss of metal on the car, and he would put a pair of cast steel wheels on the car, and his defect card on the car for the same in place of the steel wheels and the owner would be entitled to card for the difference between them. The Big Four has become responsible for a pair of steel wheels that is being slid flat 2½ inches. They would have to pay for the loss of metal on the steel tire wheel.

Mr. Gainey: Mr. Boutet does not understand this thoroughly. This is a pair of cast steel wheels that were slid flat and were ground down with emery. There is no provision in the rules to protect the car owner for the loss of service metal, and you cannot charge the wheels in the regular mode of procedure that you can the steel tire wheels.

Mr. Stoll: If it is permissible by the M. C. B. rules to turn down the wheels, the only thing he could do is to charge the actual cost of labor.

President Trapnell: All you could charge would be the actual labor in handling the case, seems to be the consensus of opinion.

Mr. Boutet: I will have to take exceptions to the ruling of the

chair. I believe we should be fair under all conditions. B slides a pair of steel wheels on one of A's cars. The car is in interchange between B and C. B is certainly responsible for the loss of metal on that wheel. I believe this association should not take the view as expressed. I believe we should look after the interests of the car owner. He has lost 1-16 of an inch of metal on that steel wheel and taken so much of the wear away from there. I believe the owner should be compensated for the loss of metal and that the man who takes it should be charged up. I move you that it be treated the same as a steel tire wheel, that the owner be protected for the loss of metal, and the man charged who did the damage.

Mr. Barker: It shows that the grinding of these wheels was not recognized by the rules. He states that he is in possession of a defect card; does not say whether it is $1.50 damage, but it is for a pair of wheels slid flat as Mr. Boutet says. We know that with the defect card he is not limited to a reasonable charge and he must protect the owner. The open knuckle is not recognized and I assume that was the point the gentleman was making.

President Trapnell: The chair recognizes the past president in this proposition. The chair said that the consensus of opinion was that actual labor was only charged. The chair cannot make the rulings. That should be done by the convention. When a case comes before this organization, it is up to you to decide it. I am an instrument in your hands to decide by vote, and your servant to do as you say. The motion before the house is that it should be treated as turning down a steel tire wheel. You have not handled the flange; you have just ground down the flat spot. Is the owner entitled to service metal of 1-16 of an inch when you have not taken the flange down?

Mr. Stoll: I would like to ask some of the roads that have cast steel wheels what they do.

Mr. Boutet: I think I have a little apology to make. I did not come up for the purpose of taking exceptions to the ruling of the chair. I simply felt that this association could not go on record as saying they were trying to beat the car owner out of anything.

President Trapnell: There is nothing personal to the chair and the apology is not necessary.

The motion was carried.

Mr. Zachritz: I should interpret the third clause of Rule 115 that if the underframe were intact and in serviceable condition, that it only required a certain amount of labor for the owner to put it in condition, he must receive it, provided he is furnished with a defect card for repairs of the underframe. If the underframe were all twisted, it would not be any money in the delivery company's pocket to send it home. They had better scrap it and pay for it. The rule says it must be in serviceable condition.

Mr. O'Donnell: Not if the car is safe.

Mr. Livingston: I do not interpret that as meaning that the frame was moving on its own trucks.

Mr. O'Donnell: I see no wrong. It is the body sent home without the trucks. I do not think he has any right to reject the body.

President Trapnell: He is entitled to a card for the destruction of the car.

Mr. Schultz: I think it has reference to any defects the frame may have and still be in a serviceable condition.

Mr. Livingston: It seems to me that the owner has already been conferred with. He evidently knows that it is coming to the owner on another car and that the car has been destroyed. You have notified him.

Mr. Adams: I would think that was put in there to protect the other fellow and not the owner.

Mr. Trapnell: He has got to return it in serviceable condition.

Mr. Adams: If the car were in a serviceable condition would a defect card be required? I do not think the owner would have anything to say.

Mr. Roof: Where steel, or steel underframe cars, are so badly damaged on foreign lines, not connected with the original car owner, it is taken up with the car owner, and they ask for a valuation on the body of the car. The owners will go back and state that the condition is such that they will not receive the car. It is up to them to repair the car. If the car is coming in on our own tracks so badly damaged, we surely have a right to say whether we will receive it or not.

Mr. Head: I find this rule is a supplement for cars destroyed. This rule is put in so we can send the underframe home, settle for the body of the car and return the truck and underframe. Heretofore we have asked permission of the owner if he would allow us to return the underframe and build a body under it under authority of our defect card.

Mr. Wymer: My thought in this matter is in accord with Mr. Head. This paragraph of the rule is placed in here to provide a way of sending home an underframe similar to the way we send home trucks. I think it is intended for the same purpose.

Mr. Barker: We have had the upper portion of stock cars planed off so that it made a flat car of a box or stock car and the trucks were somewhat damaged. That is a case that I assume that paragraph covers, where the superstructure and the trucks are damaged so that they are of no value, have we a right to load them on a car and bill to the owner?

President Trapnell: We have not.

Mr. Schultz: Where the underframe is serviceable, we have a right to send it home to the owner and card for any defects upon the underframe.

Mr. Schultz: His first duty is to report it destroyed. His duty is to send the underframe home and get credit for it. He has to card the defects provided the underframe is serviceable.

Mr. Head: I have in mind three different cases where we have done that. We made settlement for them and stated that we were not in a position to make the proper repairs to the superstructure of the car, reported the car destroyed and asked permission to send it home practically as a flat car, and gave them authority to reconstruct the superstructure of the car at our expense. Some roads have admitted that in cases of that kind the cost or expense of the superstructure shall be at the actual cost and not on the M. C. B. defect card. As a general rule, we are glad to get rid of it at anything and we tell them, "All right." It seems to me that this latter clause gives the delivering line a right to demand.

Mr. Barker: It appears to me that the receiving line has nothing to say about it. I think we should treat the owner with proper courtesy.

President Trapnell: The consensus of opinion is that the owner should be notified, taking up the question of sending home the underframe in good condition and paying for any slight damage that might be on same.

Mr. Zachritz: I desire at this meeting to make an appeal to the car foremen and general car inspectors of the United States for the purpose of asking that we all co-operate and take it up with our men with a view of getting our repair cards made out in accordance with Rule 9. I am in a position to know that every railroad in the country is carelessly violating the requirements of Rule 9. The information required is not given on the repair cards. I understand that the arbitration committee at the last convention decided that where questions of this kind come up for arbitration of the next year, it will require a cancellation of the bill. Some roads are very particular in requiring all information, but they are not so particular when they bill on other lines for the same thing. The consequence is that bills are being held up and a lot of correspondence has resulted every month in order to get bills through. I think if the Car Foremen and the Joint Car Inspectors of the railroads of the United States would co-operate we could require our repair men and inspectors to give the necessary information on the repair card, and I make an appeal that we take this matter up.

Mr. Hyman: That is a question I am interested in. There is a question I want to ask. There is a rule that says when you clean, oil and stencil a triple valve you show the kind. There seems to be a diversity of opinion as to what that means.

Mr. Zachritz: I would say that a member to the convention asked that same question of the arbitration committee and they claimed that the name of the triple valve and the class of triple should be given. They explained that in a great many instances railroads were putting on an inferior type of triple valve to the one removed, and charging the same price.

Mr. Head: Where the triple is changed you should give this information, but where you take the same triple down and clean it and put it back, it is not necessary. That question has been asked a good many times and we have accepted an explanation of that kind. Where another triple is put in, we place the name of the triple as well as the brake.

Mr. Egan: It would be well also to mention the name of the coupler removed and applied.

Mr. Gainey: Talking on Rule 9, I was of the opinion that starting on page 13 where it says "the following must be specified on the repair card," that refers to parts removed and replaced by other material, but when it comes down to where it says "when triple valve or cylinder—the initial of road and date of last cleaning must be shown." I do not believe we have to specify the kind of cylinder or triple we apply. All you have to show is the one cleaned.

Mr. Barker: Kind, what does "kind" mean? The type or the builder? That is pretty broad and it is claimed that it means both.

Mr. Gainey: It means the kind and build where you are removing and replacing, but where you are putting the same material back, I do not believe you have to say.

Mr. Pendleton: How do you make your repair card read? As I understand it "couple body complete" does not include the knuckle.

Mr. Sherman: If we apply a simplex coupler, we want it complete and we charge for the entire coupler.

Mr. Zachritz: I will say in answer to that, it cost us some money to find out something in regard to that question. We gave some offset authority because we did not specify that coupler. We had our bills held up on the small technicality of journal bearings. We had a 9-inch journal bearing applied and we did not so state and they compelled us to cancel the charge. That is why I wanted to make an appeal to the car foremen to get away from these technicalities so that our bills will go forward, and our chief clerks would not be burdened with correspondence.

Mr. Pendleton: I am glad this gentleman brought up the discussion on Rule 9 and asked that the car foremen go home and keep right after that matter and see that the repair cards are made out properly. It will save a great deal of money because when $20,000 repair bills are held up for sixty or ninety days, the interest means something, and the labor it takes to handle it over and over means something.

President Trapnell: I believe the request of Mr. Zachritz is a good one. We should go back and instruct our inspectors, foremen and car clerks along the line of making up their repair bills strictly in accordance with Rule 9, giving all the necessary data.

Mr. Boutet: Yesterday we decided to devote fifteen minutes for remarks concerning our departed members, as the time has arrived, I move you that we proceed

Memorial to Mr. Chapman.

Mr. Dejot: I regret that I have been selected for this purpose. Knowing of the qualities of Mr. Chapman, I fear that I will not be able to do him justice. However, I wish to say that Mr. Chapman

was one of the broadest minded men in connection with our line of business, a gentleman socially and in the discharge of his duties. He was a Christian in every sense of the word. All who were acquainted with him were proud to be recognized by him.

I move you that suitable resolutions be drawn here and a copy of same sent to his family.

Mr. O'Donnell: I am pleased to state that I had the privilege of attending the obsequies of Mr. Chapman at Canandaigua and while he went from this world somewhat suddenly, we all felt confident that the good soul of our brother had nothing to fear in the hereafter. The minister spoke of the fact that Mr. Chapman had led the choir of that church for seven or eight years; his heart and soul were in it for the betterment of its conditions. He was always ready with suggestions to further the Christian and brotherly spirit of each individual of the church, and in fact those of us who left the church and returned to our homes in the afternoon felt confident that we had done our duty to mankind in attending the funeral of our beloved Mr. Chapman. I had the honor of securing him as a member of our association. Possibly some of you are not thoroughly acquainted with the gentleman, but he made it a point when attending these meetings to always be present on time and showed the proper spirit by listening to the discussions and doing everything possible to further the interests of the association. His wife, and I believe one or two members of his family, were buoyed up by the fact that he lived a good life, fought the battle, and may we not hope, as brothers and Christians, that he won the fight.

Mr. Donohue: I had the honor of knowing Mr. Chapman for the past twenty years, and I was sorry to learn of his death. He was a man we all liked and a Christian. I do not believe that he had an enemy in the world.

In Memory of Charles Stark.

Mr. Boutet: Charles Stark was born in 1866 and died July 10, 1912. He was a man of excellent qualities and a good Christian in every respect. In fact, he was always one of the deacons in the church to which he belonged in whatever locality he may have been placed. At the time of his death he was associated with the Christian church at Columbus, Ohio. He was a general foreman in the car department of the Hocking Valley Ry. I first met Mr. Stark at the Buffalo meeting of this association when about a dozen went from Cincinnati. He was employed then as a joint inspector near Pittsburgh. He and his good wife attended the meeting at Buffalo and I have a photograph at the house showing the few members that were there: Charles Waughop of St. Louis, Stephen Skidmore and James Clare of Cincinnati, Charles Stark of Pittsburgh and one or two other gentlemen, myself and wife and the editor of the Railway Car Journal, also Mr. and Mrs. Berg. Mr. Stark has been a constant member of the association and when opportunity would present itself, he was always at the meetings as one of its most earnest workers. Mr. Stark's death was rather unexpected. He was confined to his bed for about a week. Although for the past year we felt that his demise was not far off. What little time he was down in Cincinnati, every person who came in contact with him felt that he was sincere—nothing on the surface at all. He made no display of his good traits—simply went along and treated his brother in accordance with the golden rule. When we have done that we have displayed all the religion that there is, I do not care to what denomination you belong. Mr. Skidmore and myself went to Columbus to attend the funeral. In talking with many of the members they state that they did not know of it or they would have been there also to show the esteem in which they held him. I regret that I cannot find words to express my thoughts, and I would ask Mr. Stoll to help me out in the matter.

Mr. Stoll: Mr. Stark was raised in my locality and I have known him and his entire family for many years, and in the community in Toledo where he was raised, they have nothing but praise for the family. I was least acquainted with Charley than any one of his family, but I am safe in saying that the whole family were highly respected in every locality where they located. This association has lost, in the death of Mr. Stark, a true and faithful member.

Mr. O'Donnell: It might not be known to the majority of the members here that Mr. Stark was with us in the East for some time, and I would deem myself ungrateful to his good brother who is with us and those who knew him, if I did not consider it my duty to rise in this meeting and say a few words in behalf of the departed brother and friend. Mr. Stark was not a person who would fall all over you when he met you, but after you became intimately acquainted with him, you naturally clung to him for his many good qualities. Mr. Stark's family, which is made up of a good many good railroad men, may feel confident that their good brother in passing away is not dead but sleeping and that the spirit will live with the acquaintances for many years to come.

Mr. Vittum: I have come in contact with Mr. Stark and known him in his official and private life. As a foreman he was exemplary. We have talked together on the subject of religion and I had an opportunity to know of the deep and tender nature of this man who has gone from us. He was a Christian man. Only a few weeks before he died he told me how he came into the church and of his high opinion for the church. I have visited in his home and no one can tell of the irreparable loss in that home because of the death of that man. I have only good things to remember and with Mr. O'Donnell, I have to say that he has gone from us fully prepared to occupy the place to which he was called.

Mr. Skidmore: I do not feel as though I could say more than has been said in regard to the good qualities of Mr. Stark. I remember distinctly the first time I became acquainted with him was over in Buffalo. At that meeting a very close friendship sprung up among the few who attended it and Mr. Stark was one of them. He was a great worker for the association. While he was quiet and unassuming, he had the interests of the association at heart. I felt deeply when I heard of the death of Mr. Stark, although when I saw him in Toledo at the last convention I thought his days on earth were numbered, as he looked bad at that time. Mr. Boutet and I attended the services and his fellow workers there showed the high esteem in which he was held at Columbus.

In Memory of Mr. Charles Waughop.

Mr. O'Donnell: I have been selected to say a few words to this assemblage out of respect to the memory of Charles Waughop. I feel that the membership will agree with me that the words that we speak here will add nothing to the life work of the good man we have lost from this association. In fact the association, without the name of Charles Waughop would not be the "Chief Joint Inspectors Association," as it originally was. The records show, and I have been told, that our departed brother and friend was one of the early pioneers of our association, in fact he was temporary president for the first three years after its birth, and at the inception of the regularly organized body at Cleveland, he became president and filled the chair for three years afterwards. Those of you who were intimately acquainted with Charley are in a better position to outline his qualities of heart and mind. My first acquaintance with the gentleman in a business way in this association was some five years ago, and every convention thereafter the good form of our friend was seen coming down the hotel lobby with the material and the mind to further the interests of this association. There were sad disappointments among its members, and the good work he has done speaks for itself. We all feel that the biblical words "Who is your brother?" would apply in this case and also for future cases as we go through life. It is not what we believe from a worldly standpoint, but what we stand for to help one another. No matter what color, creed, disposition or clothing the human being may wear; always give them the helping hand of charity, because the burden is heavy. Let us carry it through life in kindness and charity, and in this way lighten the burden of those of us who are here until we are called hence. The soul of Mr. Waughop was honorable; his tongue was his worst side. His heart was ever kind to the oppressed. He had a loving wife and family. I know we cherish the feeling that he may look down upon us with kindly spiritual eyes and say, "I have done the best I can and I hope that your prayers may follow me that my works may be eternal, and that the association will do the best it can to further the interests of the worldly works." And when we pass along some kind friend will say: "He has fought the good battle and he has won out. Peace to the honorable spirit of our friend from St. Louis and comfort to his wife and children."

Mr. Boutet: I feel, as in the case of Mr. Stark, that I cannot find words to express my feelings as to our brother Waughop. We were personal friends for years. At the first meeting to organize the "Chief Joint Car Inspectors," I got my executive committee to call a meeting of the inspectors throughout the country for the purpose of trying to arrive at the real understanding of the rules. At that meeting Charles Waughop was appointed chairman. We adjourned from there to go to Kansas City. We held four meetings and the first permanent organization was created at Cleveland, and Waughop was the first president. The association may live to have a hundred thousand people enrolled as its members, but you will never have a member of this association who will take any more interest than Mr. Waughop. At first it was a case of Mr. Waughop going down in his pocket to help defray the expenses of this association. We were few and we were not in a position to help financially, and the association would have been abandoned several years ago had it not been for the assistance of Charles Waughop. He and Mr. Skidmore and one or two others were the main stays of the organization. It was up-hill work and we have a good many new members, but it will be hard to find any one who will take the place of Mr. Waughop in this association. One of Charley's favorite expressions was: "When I am gone remember me as a good fellow," and I hope every member who knew him will remember him as one of the early supporters of this organization.

President Trapnell: Mr. Waughop being one of the originators of this association, the majority of the old members know him. They may wish to say a few words in commendation of his life, his character and his ability.

Mr. Zachritz: As the gentleman just remarked, Mr. Waughop was one of the originators of this association. I knew him in 1887 and we who knew him then knew him to be a jolly good fellow and a prince among men.

Mr. Lynch: I had the pleasure of being acquainted with our deceased brother for the past eight or nine years and found him to be a man of the highest honor, integrity and good-fellowship. I attended his obsequies on a hot Summer day, and I think that would attest to the high esteem in which I held our brother. I might simply quote the words of Shakespeare and say: "He was the noblest Roman of them all." The elements were so mixed up, that all the world might say he was a man. The same authority has said, and too often it is true, "The evils that men do, live after them, the good is oft interred with their bones." While we here to-day, in our humble way, pay tribute to the memory of Chas. Waughop, let us not forget to emulate his good qualities, and at the same time extend our heartfelt sympathy to his bereaved wife and family.

Mr. Pendleton: I had the pleasure of knowing Brother Waughop for nineteen years, fifteen years of that time I was intimately associated with him in a business way and a fraternal way. I had the honor of being his assistant for four years at St. Louis and I never met any one who had a kinder heart than Mr.

Waughop. He was always considerate of his subordinates and all those with whom he came in contact. He dispatched the business with a kindly spirit; his character was above reproach, and I feel that this association in his passing away, has lost a very valuable member, one whose place will be vacant for some time to come. Brother Waughop's death was not expected. We all felt deeply grieved when the announcement was made. Personally, I felt that I had lost the dearest friend because Charley had always befriended me when necessary. I felt like the country had lost a faithful, and upright and honorable citizen; his family lost a dear husband and loving father. I attended his funeral, and as Brother Lynch said, it was a very hot day, I believe 107 in St. Louis that day and the large throng of people gave evidence of the high standing of Mr. Waughop in the community in which he lived. His many friends were there to pay their last respects, and they were all deeply grieved. This association has lost a valued member.

Mr. Berg: I am in a rather delicate position to make any remarks. I am somewhat emotional and it has been rather difficult to restrain myself ever since I heard of Brother Waughop's death. I have somewhat the same disposition and I think I understood him as well as any man in this association. I felt that he was sometimes misunderstood in some of the expressions he made, but I assure you that, as the rest have said, we will never have a member of this association who will have its interests at heart more than Brother Waughop. He was broad-minded and generous to a fault, and I regret very much that I am unable to express my sincere regret in the loss of Brother Waughop.

President Trapnell: It is indeed a very sorrowful mission to rise before a body of men who was so intimately acquainted and co-workers with Brother Charles Waughop, to tell any more of his qualifications. He was generous and big-hearted. He came to the help and assistance of any friend, and I may say foe against him. When a friend was necessary we could depend on Brother Waughop, and he was ready to respond. In his everyday life he was well thought of and highly esteemed. I am advised that he had the largest mid-week funeral that ever took place in the city of St. Louis. The sorrowing friends came and filled the church to overflowing. It took five of the large street cars of St. Louis to take the friends to the cemetery, besides all the carriages. They laid him away in a manner befitting a king, and when I thought that Charley, a mortal man, commanded the respect of the citizens of St. Louis and the citizens of the United States wherever he mingled, it certainly was a grand thing for this association to say that he was one of its founders, one of its co-workers, one who buckled on the armour and fought the good fight for this association and through his aid and assistance, brought it up to the standard it enjoys today. Charley Waughop was a man who, whenever you went to him for advice, you always got it. We did not always understand him when he made a curt, short reply, but he left you to figure it out. He did not want to do your figuring for you. He told you what was what, and if you did not understand, you could go back and Charley was there to make it plain and put you in the right path. This association has lost a valued friend and faithful worker and one whom it will be hard to replace. The Lord says that he will always bring up a Moses to lead the people, and we trust that in the departure of our friend and co-worker, Charles Waughop, he has gone to receive the reward which he well earned upon this earth.

Mr. Covert: If there are any of you who would like to see the terminals and the packing house, or anything that we would be able to show you in the few hours that you could give us, we would be glad to send automobiles for you and take you out to the Swift Company's plant for lunch. If you will let us know how many will be in the party.

It was moved that the invitation be accepted.

And thereupon the meeting adjourned until Thursday morning.

President Trapnell: The first order of business to come before the convention this morning is the continuation of the discussion on M. C. B. rules. Is there any one present who desires any rule to be discussed further?

Mr. Schultz: Our present Rule 1 provides for the running care of cars in regard to oiling and air brake attachment. They are, however, not paying any attention toward the repair of foreign cars. I would like to have inserted in that rule just one more word "repairs." There are in this city today, I should judge, 1,000 cars that have worn out in this circle. They are in such condition that they do not get out of this terminal. This is due to the fact that the railways are doing very little to them, passing them on to the neighbors who are transferring the cars and sending them back to the delivering line. Frequently a car is loaded again for the same destination and transferred. If it is not, it is loaded for some other road. If everybody would give this foreign car equipment the necessary care, these conditions could not exist. I would like to call attention to the matter of home route cards. If I had my own individual way in the matter the rules pertaining to home route cards would be taken out of the book of rules, and if that were done the cars would have to be taken care of where they happened to be. The reason for running a car home on a home route card is because it is worn out and unfit for service. You haul a non-revenue car and a bad order car. You put it in a heavy train which results in frequent wrecks. It is no use to the owner and it is a detriment to the handling line, and for those reasons we ought to do away with the license of running home cars in that way, resulting in expense, taking the space in trains and producing no revenue.

Mr. Kyle: Wouldn't it be a good idea if we could suggest to make all railroads responsible for all repairs excepting wrecks, and do away with all of that?

Mr. Zachritz: I suggest that this be referred to the different car foremen for discussion during the ensuing year with a view to getting the consensus of opinion all over the country, and have the matter referred to the arbitration committee at the proper time. I make that as a motion.

The motion was unanimously adopted.

The president: He also makes reference to the home routing of cars.

Mr. Zachritz: It was my intention to put that in the motion.

The President: I will put that separately.

Mr. Cox: We have made this recommendation a good many times and we should not run cars home for repairs. The only way I see to get around that is to cut out the combination. That will stop the home route cards.

Mr. Schultz: Even though we have not got to that stage of the game, I feel that the present rule under which we are operating is adequate to take care of the cars, without the necessity of taking the worn out car home. If it is dangerous, there is absolutely no reason for it, and from any angle that I can look at it, I cannot see why the railway cannot take care of the worn out car. Under the system of inspection like we have today, the car can be inspected and reported to the car owner, giving him the facts and it is then up to him to say what he wants done with the car. If the privilege of home routing the car is taken away from him, he may see to getting it repaired. You may bill me for the worn out parts that are repaired. If they are not worn out the company having the car can get pay for it. If we would all take care of the cars, there would be more revenue cars today.

Mr. Boutet: I do not know of any better remedy than was recommended by the Executive Committee of this association three years, ago, that we did not have any old or worn out cars. If a car gets in the condition that it exceeds the combination, have a joint inspection, or a representative from another road to make a statement, and the owner can say whether or not he shall repair the car or have it destroyed. That would stop the running around the country of empty cars. The arbitration committee turned our recommedation down. If this is going to help the matter, I want to see it go through. When a car becomes unserviceable, let it be repaired and put back in revenue service.

Mr. Barker: That recommendation has borne fruit. The Arbitration Committee since that time, in the line of their decisions, have given authority to the road in possession of the car to write to the owner and request authority to bill for extensive repairs. If the owner does not send a representative and make joint inspection, then they repair the car and bill the owner. If we will study the arbitration decisions, we will learn that the home route business has virtually been wiped out, if the Chief Joint Inspectors know what is a worn out car.

Mr. Schultz: I do not think so. The trunk lines will say: "We have a worn out car given to us by our connection." It is up to them to get a home route card. If that privilege were taken away, they would not have that right.

Mr. Berg: I do not know as you should blame the chief joint inspectors for not getting full movement of cars. They were born from the fact that there was congestion at the big interchange points, and some have thought that this association got in wrong sometimes that we have dictated or ruined our prestige by trying to persuade members to get away from the M. C. B. rules. As I understand it, there was congested points like Cincinnati, Chicago, St. Louis and so forth, and the joint managers called upon these gentlemen and asked them what they could do. The chief joint inspector would readily suggest something. We moved the cars since 1907, that is the year they started out all the rattle traps that have been moving ever since, and I think the whole trouble rests with the foremen and not the chief joint inspectors. In the first place they headed off cars that were unfit for service. It is the chief joint inspectors' duty to see that these cars are moved as soon as possible, but when it is loaded it is their aim to get the car back over the route that he received it. Getting home route cards is a difficult task, because it seems that every foreman who gets a car home seems to be looking for some defect that forms a combination so he can get joint evidence, and everybody is discouraged trying to get home routes. If you ask for a home route and describe the condition of the car a great many will question your veracity. When you get the car home, then there is nothing said about the condition of the car. It goes to show that they are taking undue advantage. Or, in other words, they haven't the confidence in the man who reports the condition of the car that they should have. We have a great many who like to pass cars that any owner should take home even if there was what could be termed a combination.

Mr. Boutet: I hope Mr. Schultz is not going to insist on again referring that rule until he goes over our old recommendation. I think if we take care of our old recommendation, it will bear fruit.

Mr. Schultz: I believe that any suggestion or recommendation of this association should not be made except on due and deliberate thought as to what would be advantageous for the interchange of cars. If we cannot get that recommendation, is there anything else that would better the condition? I do not desire to shut off any discussion on the matter. The executive committee, I feel, will want to consider the views of the members, and I hope the discussion will proceed.

Mr. Elliott: It appears to me that we are overlooking a very important matter. The Terminal R. R. Association of St. Louis I think repairs as many, if not more, foreign cars than anybody in the country, and it is frequently the case with us that we have bills turned down and sent back to us for repair cards with

the note that "This is extensive repairs, and the owner should have been conferred with." If we take the matter up with the owner, we are still paying a per diem on that car all the time we have it. Sometimes it is two months before we receive an answer. Whenever we make repairs at the present M. C. B. prices we certainly lose money. I do not see how you could compel anybody to repair old and worn out cars at a distinct loss to them- by Mr. Boutet, that we make a joint inspection by the party selves. If the prices were increased and that part of the rules pertaining to extensive repairs were put in in the way suggested making the repairs and some disinterested person, I believe it would have a tendency to eliminate a lot of old worn out cars. We certainly do not want to hold cars a month or two and pay a per diem in addition to what we lose in making the repairs. I believe if the prices were raised so we could come out even on the proposition, some benefit would prevail all over the country.

Mr. O'Donnell: You may feel that this discussion will bring out some good points, but this same discussion has taken place for some years past. The A. R. A., with the M. C. B. are doing the best they can to bring about results. All we can do is to recommend that some definite action be taken as quickly as possible to bring about the results to better conditions.

Mr. Pendleton: I believe the Executive Committee should confine itself strictly to the worn out car, and the arbitration committee will do something on that.

Mr. Schultz: I feel that the price to be charged will be regulated in the near future so we can afford to repair these cars. It is not fair for those of us who run shops and know what it costs to take in a worn out car and repair it. The prices are not right. I think the matter is before the proper parties so that within a short time we will get, in addition to our present M. C. B. prices, a percent that will cover that expense, and if that is done and the privilege of home route cards removed, the matter will be taken care of. It has been suggested that it will be necessary, unless relief is gotten pretty soon, to establish a grave yard for the cars where they can be seen and the owner notified, waiting his decision.

Mr. Elliott: As you all well know, we have the bureaus for inspection at the large interchange points, but why wouldn't it be possible (and what association is better qualified to recommend than this association) that a bureau for the repair or taking care of in some manner, of all foreign cars, be established at large interchange points? In other words, say you have a shop and that shop would be the home for all worn out cars. Those people would represent the owners of the cars. If you stop to consider what that would save, I think that would be a good solution. It would have to be worked out by a committee, but I think that would take care of the foreign cars and save delay.

Mr. Zachritz: There is one other thing I would suggest and that is the stoppage of per diem charges on the cars, repairs for which have been taken up with the owner. Often times we ask the owner for privilege to repair, and all of the profit is eaten up in per diem charges waiting for his authority. Of course this per deim charge comes under the car service department, but I think our committee could do good work if they would work with such organizations to get that changed.

Mr. Head: I think we should take into consideration the per diem charge. Perhaps some of you have already felt a new influence on the management on per diem charges. The 1st of January it goes up to 45 cents a day. If you have to haul worn out cars 150 or 175 miles, or wait two months for somebody to give authority, the per diem is going to eat up everything. Forty-five cents a day for 365 days amounts to about three times the annual cost of maintenance and equipment, taking into consideration everything that goes on repairs to cars. The average cost of repairs to cars throughout the country is in the neighborhood of $50.00 a car. At 45 cents a day you will have in the neighborhood of $150.00 a year and that is being now considered for the purpose of enlarging owner's responsibility, which will have a tendency to cut out a great many of these combinations. The charge per diem will be so regulated that the owner can afford to have his car repaired by a foreign line. I want to make the point that the per diem question should have very careful thought before we ask the railway to take care of somebody's worn out equipment.

Mr. Schultz: The question of per diem has been given some thought. It was to move the car on the arrival of the car in the yard. The only question that they hinged on was the possibility of wrong repairs on a car, and the arrival of such cars home as wrong repairs made by such a neutral shop, in what manner could the owner be compensated for such wrong repairs. So many cars of different construction would arrive that it would sometimes be necessary to make wrong repairs. That was the only objection raised to the proposition. The repairs of worn out cars is confined to wooden cars, and the possibility of wrong repairs in wooden construction is very slight. The only matter would be the casting and in a majority of cases that would be missing material, and under our present method of interchange would be cardable. I am not clear as to what relief the car owner would get if the car arrived home with wrong repairs.

Mr. Hiatt: We talk about worn out cars and a shop for repairs, I think the only solution of the whole matter is that the car owners of this country should be responsible for all repairs. A car comes into the yard, if it costs 25 cents to repair it the car is run over the country, and at the end of the month it costs $10.00. If we made small repairs it would prevent big ones.

Mr. Elliott: We have so many M. C. B. castings that it would not be a big proposition to carry in stock the different styles.

Mr. Zachritz: In line with Mr. Schultz's talk in regard to wrong repairs at his grave yard, brings to my mind the recommendation made by the Twin City car department several years ago, and that is to do away with the wrong repairs idea. They can take care of it with such material as will take it home and let the owner repair it. Where a man makes repairs using material that is not standard to the car, he has to give them to the owner. If they would cut out wrong repairs, repairs would be made that are not made now.

Mr. Gainey: Speaking from shop practice I am of the opinion that if the men who are in charge of the different plants along their own lines will get down and repair their own cars and put them in proper condition, instead of trying to make a record on paper to their superiors, we would not have the cars on the repair track today. The foreman wants to make a record to the superintendent of motive power and he to the general manager, and the cars are run out of the shop with only about one-third of the work done. You will find that is the trouble with so many bad order cars today.

Mr. Schultz: Along the line of the talk that was had here this morning, I offer the following resolution: That it is the sense of this meeting that at large terminals ways and means be provided, under the supervision of the Master Car Builders' Association, or any other governing body that would have authority to provide ways and means to take care of the foreign equipment that arrives from other large terminals in a worn out condition.

President Trapnell: The resolution is handed to the executive committee to report to the arbitration committee.

Mr. Schultz: The condition exists now.

The President: If you desire to have it in immediate operation, I would refer same to the executive committee for immediate action.

Mr. Elliott: I do not mean that this car be only temporarily repaired, but that it be put in first-class condition.

The President: That is the sense of this convention. I believe everybody understands it.

Mr. Wymer: If a sufficient number desire to take in the trip around the Chicago Terminal tomorrow morning, I will say on behalf of the Belt Railway of Chicago, that the engine and necessary coaches will be provided.

Mr. Smith: Can we charge for a forged steel when cast steel are standard to the car?

Mr. Zachritz: It is my opinion that you would charge for the forged steel wheel the actual price and give the proper credits for the cast steel; that was the intention of the rule permitting you to substitute one for the other.

Mr. O'Donnell: I think it only proper just at this time at the close of our exercises in convention that we should recognize individually and collectively the excellent entertainment and business, and papers, exhibits, etc., that we have had here during this convention, and I move you that this body pass a set of resolutions extending its thanks to each member of the entertainment committee as a body and the chairman, especially; also the gentlemen who have been here the past three days looking out for our wants on the exhibits; the hotel people for the generous treatment; the contributors are always thanked, and if I have omitted any the secretary will include them.

The motion was passed unanimously.

The following railway supply concerns contributed to the entertainment fund of the association:

American Brake Shoe and Foundry Co.
American Car and Foundry Co.
American Steel Foundries.
Armour Car Lines.
Bettendorf Axle Co.
Buckeye Steel Casting Co.
Chicago-Cleveland Car Roofing Co.
Columbia Nut and Bolt Co.
Chicago Railway Equipment Co.
Camel Co.
Franklin Railway Supply Co.
Grip Nut Co.
Gould Coupler Co.
Galena Signal Oil Co.
Hewitt Supply Co.
Imperial Car Cleaner Co.
Imperial Appliance Co.
Jones Car Door Co.
Joyce-Cridland Co.
Lehon Co.
McCord and Co.
Morris and Co.
McConway and Torley Co.
National Malleable Casting Co.
Pennsylvania Specialty Co.
Railway Materials Co.
Standard Railway Equipment Co.
Spencer-Otis Co.
Swift and Co.
Scullin-Gallagher Co.
Standard Car Truck Co.
Symington Co., T. H.
United States Metal Mfg. Co.
Union Draft Gear Co.
W. H. Miner Co.
Westinghouse Air Brake Co.
W. P. Taylor Co.
Ward Equipment Co.
Woods, E. S.
West Disinfectant Co.
Wood, Culford S.

Election of Officers.

For president of the association for the ensuing year the name of Jamel L. Stark, vice-president, was placed in nomination by Mr. Boutet. On motion the rules were suspended and the president cast the vote of the entire convention for Mr. Stark.

The name of F. C. Schultz was placed in nomination for vice-president, and on motion the rules were suspended and the secretary cast the unanimous vote for Mr. Schultz.

Mr. Schultz: I accept the office and I thank you very much for the confidence and respect you have given me. I trust that nothing will happen during my term of office that will change your opinion of me as expressed here today.

The President: The chair doesn't get ahead of himself very much, but he has to acknowledge that he has made one mistake. Before proceeding further I desire a resolution from the membership respecting the salary of the secretary-treasurer.

Mr. Boutet: It has been customary every since the infancy of this association to pay the secretary what we can afford. Last year it was $100. There isn't a man in the room who would do the work for three times the amount. We have a good secretary; he has been faithful and done the work in an admirable manner. If this association paid him $300.00 it would not be enough for the amount of work he does. I move you that the rules be suspended; his salary fixed for next year at $150.00 and that $50.00 be added to the salary for the past year, as the condition of the finances will permit it.

Seconded by Mr. Schultz.

The President: The motion includes $50.00 for the past year. I shall have to rule that out of order at this time. I will entertain a motion to go back after I have handled this.

Mr. O'Donnell: I fully agree with the previous speakers but I think the question of salary should be passed upon by our executive committee and not brought out in open discussion in this convention. It is no time to bring up these questions. Haven't you made msitake No. 2? I do not see any tellers.

Mr. Boutet: Our executive committee is composed of broad-minded fair men. They want to pay what is a fair compensation. We are unable to pay a fair compensation, but let us come as near it as we can. I include in that motion that the rules be suspended and that he be paid $50.00 additional for last year.

The motion that $150.00 be paid for the ensuing year was unanimously passed.

Mr. Boutet: I now move you that his salary for the past year be $150.

Seconded and carried unanimously.

Mr. O'Donnell placed in nomination for secretary, Treasurer Stephen Skidmore. It was moved that the rules be suspended and that the president cast the ballot of the association for Mr. Skidmore. And Mr. Skidmore's election was declared unanimous.

Mr. Gainey: By the election of Mr. Schultz your vice-president, it will leave four members of the executive committee to be elected instead of three. You have in this association a man who has worked harder than any other member. He retires from office at the close of this meeting, and I would like to ask permission of the chair and the members of this organization to suspend the rules and elect Mr. Boutet, your past president, as a member of the executive committee in Mr. Schultz's place by acclamation.

Seconded by many and unanimously carried.

Mr. O'Donnell: I would ask that you kindly suspend business a moment or two to show your appreciation of the gentleman who backed up our good time in Buffalo some three years ago. There is always a power behind the throne. I have the extreme honor of introducing to you W. O. Thompson, chairman of the Niagara Frontier agreement. He is also secretary of the Traveling Engineers' Association.

Address of Mr. W. O. Thompson.

Mr. President and Gentlemen: Everytime I get around where Tom O'Donnell is I get stage fright. However, I am very glad to greet the Chief Interchange Inspectors and Car Foremen. I take it you are represented from all over the United States and Canada. You are a class of men that I have come to have a great deal of admiration for. I am here this morning under a wonderful disadvantage. Up to five years ago I had nothing whatever to do in the car department. I was a locomotive man, but the New York Central made the fatal mistake of putting me in one of the biggest car department districts perhaps in the United States. I know how I have kept the job all right. I have kept the job by having one of the most loyal, energetic, honest and faithful lot of men around me that God ever had the privilege of putting together, and the best lot of officers that I think were ever put together. A man coming before you like I am this morning is like a cat in a strange garret. I cannot talk to you about car matters, although I have learned the difference between a gondola and a box car. The only thing I can say to you is on the subject of organization.

The organization of the chief joint inspectors, in the opinion of the speaker, is one of the most important organizations in the railway world. I sometimes think that even you gentlemen in your positions, and to occupy your positions you must certainly have been in the service of the railways for a good many years, do not realize the important corner of the service you occupy in our vast systems.

The railways of today are unfortunately in a very precarious condition; pounded on one side by adverse legislation and on the other side by increased cost of material and supplies, our managements are placed in anything but enviable positions, and the margin between the income and the outgo has become so very narrow the only way for our railways to keep out of bankruptcy is the savings that can be made in the cost of operation, and gentlemen, I want to inform you that you can do great work in this direction.

Consider a moment, if you please, there is two and a half millions of freight cars in this country; just imagine if you can in some way a scheme to get ten rods more per day out of the rolling stock that is now in existence, the total amount for a year would be enormous and I am glad to say it is being done, as the daily car movement per day is being gradually increased year by year, and it is the firm belief of the writer that your organization has in a large measure been the means of bringing about this very desirable condition, as your annual meetings, when you get together, bring up the live subjects of the day, thresh them out and agree as to what action will be taken to improve the movement of freight, and it being fully understood all over the country from tidewater to tidewater and from the gulf to the straits make one great grand organization by which the best possible objects are obtained.

The business of our railways has become so large, the interests so varied and intricate, that quite contrary to a few years ago it has become impossible for any one man to try to take care of and master the details of our organizations, and in my opinion there is not any part of the organization where so much can be done and saved as by the hearty co-operation of the joint car inspectors of our railways.

A few years ago organizations of this and other kinds were looked upon with suspicion and disfavor by our managements, a good many of our superiors being inclined to think that perhaps we would gain too much knowledge by getting together and exchanging views, etc., but I believe, with a few exceptions, the time has come when it is considered by the heads of our railways that proper organization in the various departments has become indispensable.

The speaker is a firm believer in organization and believes he is fully competent to give an opinion on the subject, as 20 years he was very prominently connected with the movement of organizing the Traveling Engineers' Association—and has the honor of being its only secretary during its life—through which the traveling engineer becomes personally acquainted with several hundred people in his own line of business, scattered all over the United States, Canada and Mexico, he knows what his associates are doing on their respective lines, he gains valuable knowledge from them, and vice versa, and when I inform you gentlemen that twenty years ago when the speaker was trying to get enough men together to start the organization of the traveling engineers, it took him three months to find out the names of fourteen men in a like position, and the one whose territory was farthest away was one 300 miles away, and those of you who are the best organizers of your own forces at home are the most firm believers of organization of the character which you are representing.

Your speaker has the honor of representing, I presume, the largest car department district in the United States; he also has the honor to represent in the capacity of chairman of the executive committee of the Niagara Frontier Car Inspection Association, and while it is not the largest interchange agreement in the United States, yet it is one of no mean importance, and when I tell you gentlemen that in the past year, with an interchange of approximately three million cars in the territory of which I have entire supervision, and about a like number of cars on the Niagara Frontier, and that I have not had but three meetings of the Niagara Frontier Executive Committee and four cases of interchange matters that have been brought to my notice, I know you will agree with me that I believe in organization and that I can safely preach it because I am practicing what I preach.

In our little corner of the railway world it is nothing but organization; we are a great big family; we have nearly four thousand children, and they play in the back yard together very nicely.

In looking around the room I see that I have made good in having my district represented, and also believe that if you will take the trouble to talk with the gentlemen you will find them all satisfied, all happy, all of them ready to take off their coats and do their best at any and all times; I believe they will all tell you that they know exactly where they belong in the organization and that it is the only kind of organization to have.

It has been the source of a great deal of regret to me that I have not been able to meet with you and listen to your deliberations during your—as I understand—very successful meetings, but I want to assure you that my heart is with you and if at any time I can do anything for you, either individually or collectively, you will only have to touch the button, as I realize how important and how necessary to the railroad world your organization is.

I wish you all a safe journey to your homes and sincerely hope that in another year I will have the privilege of meeting with you and gaining a whole lot of information that I have missed this year and that I sadly need in my business.

Gentlemen, I thank you.

The President: I desire to extend the thanks of this association to Mr. Thompson for the able address he has given this body. We are each in accord with him in the line of duties on the Niagara Frontier in the splendid representation he has there in T. J. O'Donnell.

Mr. O'Donnell: This association in the last five years has gained from the eastern section no less than fifty-eight or sixty members. The power behind the throne that gave us the opportunity of soliciting and permitting these gentlemen to come to the meetings is the gentleman who has just spoken to us at this time. I feel that it would be ungrateful if I did not make this remark

in the presence of Mr. Thompson. I thank this gentleman for coming over to visit us. I think it is fully appreciated that in union there is strength and an organization of car foremen will solve the perplexing questions at the different interchange points.

The following names were placed in nomination for members of executive committee: C. J. Wymer, E. Pendleton, J. W. Stoll, F. H. Hanson, E. R. Campbell

The ballot resulted in the election of the following: E. R. Campbell, J. W. Stoll, F. H. Hanson.

Announcement was made that as soon as the convention adjourned the executive committee would go into session.

Secretary Skidmore: I received an invitation from Niagara Falls yesterday, offering us a number of inducements to hold our next meeting at that point.

Mr. O'Donnell: I would like to see you out in our section again, but I do not think we can give you any more new members there, and while Niagara Falls would be a most beautiful place to hold the next convention, you won't get any new members. If you would consider Montreal, St. Paul or some southern city, I think it would be better from a numerical standpoint. Mr. Campbell has been after us for two or three years. St. Paul has promised us forty or fifty new members. While I would not select any place personally, I hope new members will be the principal point in selecting your convention city for 1913.

On motion duly passed all correspondence was referred to the executive committee with authority to select the next meeting place.

Mr. Boutet: We have Mr. L. F. Wilson with us, editor of the Railway Master Mechanic. It has been intimated that we did not have enough articles pertaining to the car department. The editors are not to blame. They have stood ready at all times to print articles pertaining to car work or car interchange. In talking with Mr. Wilson yesterday he agreed to furnish each member of this association two copies of the proceedings of this meeting in addition to the regular copy of the "Master Mechanic." I would move you that the Railway Master Mechanic be made the official organ of this association for the ensuing year.

Seconded and carried unanimously.

Mr. Wilson: Before I thank you for the action you have just taken I want to criticize you. Yesterday two or three of you criticized me, and I am a little roily under the scalp. I have watched this association for perhaps four years, and I have been closely enough associated with some of your officers to know pretty well what you have been doing. I go down to the Master Car Builders and Master Mechanics' meetings. I am a member of the Traveling Engineers' Association, and I am in pretty close touch with most of the railway associations including those of the car department. I feel that in this association there is a little bit too much of the spirit of "Let Bill do it." In this case it is "Let Henry or Steve do it." They have done it, but they have done too much of it. When I was reproached yesterday for not publishing anything with respect to this association in the last issue of the Railway Master Mechanic. I felt like saying: "Gentlemen, it is your fault."

There are a great many of you who have in your offices the services of a stenographer, and if you are too busy during the day, the railroads do not employ you for all of the twenty-four hours, and you could send me something to print. I do not think I have ever received a line in my office from any member of this association other than from Mr. Boutet and Mr. Skidmore. Perhaps Mr. Trapnell and Mr. O'Donnell have sent something but I do not recall it now. If I have been at fault in not soliciting enough I take this opportunity of asking that in the future, if anything of news interest comes up with respect to this association or any of its members, you have the use of any one of our twelve issues for exploiting that news. In publishing your proceedings you have one issue, but we are perfectly willing to use as news anything that you will send in at any time during the year.

I want to thank you for making the Railway Master Mechanic the official organ of the association for the next year, and we want to do better by this organization.

We will send two copies of the "Master Mechanic" to every member of the association, and we will send ten or more to any member who asks for that number.

Mr. O'Donnell: I suggested yesterday to Mr. Wilson that he publish our proceedings in pamphlet form outside of the regular issue, and in that way we could distribute them to the rank and file of the men in the yards. They could keep them in their desks and refer to them. This would create a lot of interest as to what we are doing at these conventions.

Mr. Wilson: We would be willing to do that but we do not see where very much would be gained by it. If it were true that the "Master Mechanic" contained so much gilt-edged matter that we would be unable to supply you with more than one copy, it would be a good thing to get a lot of these pamphlets; but that not being the case, if you want to supply every one of your foremen and friends, you can have enough, but you should give us some idea of how many will be wanted. To make a reprint in the form of pamphlets we would have to reset the type because the width of the type is not such as would make a reprint in that form. I question as to whether there would be enough benefit from it, considering the fact that any of your car foremen can have copies of the "Master Mechanic." If desired we can reprint the pages of the "Master Mechanic" which contain the minutes of this association in the same size as its pages.

President: That is a matter that can be left to the executive committee.

I take pleasure in introducing to you your president for the ensuing year. I trust that each and every member, and each officer, will give to Mr. Stark the same courteous treatment, the same attention and the same help that you have given to your retiring president. This association is growing. It is up to the president at all times to mould the thoughts and opinions of the membership in the line of advancement along car department matters, and I know that in the gentleman before you, you have made no mistake.

Mr. Stark, I pin upon you this badge, the emblem of authority of this association until your term of office shall expire.

Gentlemen, it gives me great pleasure at this time to introduce to you President Stark.

President Stark: I wish to thank you for this honor, I do consider it a high honor, the highest honor that can be bestowed by this association upon any individual member. I can frankly state that I did not seek this distinction, and not having sought it, it is all the more appreciated. I feel, as the time draws near to assume this responsibility, that it is indeed a great responsibility. When I think of the able men who have been your president during the existence of this organization, I feel as though I were not able to fill the place. We all recall the able and efficient services of our departed brother, Charles Waughop, and of our hard-working friend, Henry Boutet, also the valuable services of our past president, Mr. Trapnell. We all appreciate the hard work that these men have performed in keeping this association alive. We are bound to admit at this time that it is a very live organization. However, I can only offer you my best services, and will promise you that I will do everything within my power to advance the interests of the Chief Interchange Inspectors and Car Foremen's Association of America. This association is not in its infancy; it is now a full grown child. I think we have accomplished a lot of good in the past, and the time is coming when our superior officers and in fact the different officers of the railroads of the country, will begin to recognize this association as a very important one. The time has come when they are willing now to listen to recommendations from this association, and I think in the future they will be glad to listen to further recommendations. In accepting the office of president I ask for your hearty co-operation. I do not hope to succeed without the loyal support of each individual member. I predict for this association a brighter future than it has had in the past.

Mr. Lynch: I think it would be fitting at this time that this association show its appreciation of the work of the secretary and treasurer. He has been in the harness working day and night, and I move you that a rising vote of thanks be tendered him.

Mr. O'Donnell: I move you that we include Miss Unkenholz in that resolution, and tell her we think just as much of her as we did in years gone by.

Seconded and carried unanimously.

Convention adjourned.

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C. V. Ratcliff, G.C.I.—C.&O.R.R., Covington, Ky.
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C. Zorin, G.C.I.—Soo Line, Stevens Point, Wis.

RAILWAY CONSTRUCTION.

The Minneapolis, St. Paul & Sault Ste. Marie has given Fred Baxter, Superior, Wis., a contract to build a three-mile extension of a mining spur to the mines on the Cuyuna range, Minn.

It is said that the Union Pacific will make a cut of 100 miles in the distance between Denver and St. Joseph. The new route will be over the main line from Denver, by way of Julesburg to Gibbon, Neb., thence over a new road to Hastings, from which point it will use the tracks of the St. Joseph & Grand Island into St. Joseph.

Contracts were to be let by the Quanah, Acme & Pacific on September 3 to build a 40-mile extension from Paducah, Tex., west.

President Elliott of the Northern Pacific announces that the line between Seattle, Wash., and Sumas, on the Canadian border, will be rebuilt next year with better grades, reduced curves and heavier rails. Several steel bridges have been built by agreement with the Canadian Pacific for trains to enter Tacoma and Seattle over the line. The double tracking of the Tacoma-Portland line will be finished in October. The Tacoma-Tenino line will not be completed for about 18 months.

The Platte valley line of the Union Pacific will be built as far as the upper Mitchell valley this fall. This line, which leaves the main line near North Platte, will ultimately be built west to a connection with the main line at Medicine Bow, Wyo., which will give the Union Pacific R. R. a water grade for fast freight trains, and the climb of Sherman hill will not be necessary, although the main line will continue to be used for passenger traffic.

The American consulate general at Ottawa, Canada, reports that tenders are being received for the construction of the section on the Hudson Bay Railway from Split Lake Junction to the terminus.

The Chicago & Western Illinois Traction Co. has been incorporated in Illinois with $200,000 capital, and office at Canton, Ill. The plans call for building from Pekin, Ill., north to Peoria, thence west through the counties of Peoria, Fulton, McDonough and Hancock to Hamilton, thence crossing the Mississippi river to Keokuk, Iowa, about 100 miles.

The Sand Springs Railway will build from Tulsa, Okla., northeast via Owasso and Collinsville to Nowata, about 45 miles. The maximum grades will be 0.8 per cent, and maximum curves 3 deg. There will be two steel bridges, each 100 ft. long. Both steam and electricity will be used for motive power. Charles Pahe, president; W. H. Hendren, chief engineer, Tulsa, Okla.

The Orange & Northeastern has been incorporated in Texas with $100,000 capital and headquarters at Orange, Tex. The plans call for building from White City, San Augustine county, Tex., east through Sabine and Newton counties to Burkeville, thence to a point on the Sabine river; also for building a 14-mile line from Orange to Nibletts Bluff, La., a total of about 126 miles. The headquarters are at Orange, Tex.

Tenders are being invited for material for the construction of a 31-mile section of the Bahia Central Railway of Brazil at an estimated cost of about $780,000, and for the construction of the first 31 miles of the Sao Francisco Railway with the Bahia Central Railway at an estimated cost of about $635,000. Also for the construction of a 40-mile section of the Piquote-Itajuba Railway at an estimated cost of about $2,675,000.

Remarkable Locomotives of 1911, As Tabulated by J. F. Cairns in Cassier Magazine.

T = Tank Engine. C_4 = Four-Cylinder Compound. CM = Mallet Compound.
B = 3′ 6″ Gauge. D = 3′ Gauge. E = 5′ 6″ Gauge. F = Metre Gauge.
S_3 = Three-Cylinder Simple. S_4 = Four-Cylinder Simple. A = Articulated.
G = 5′ 3″ Gauge.

Railway.	Builder.	Type.	Superheater.	Cylinders, Inches.	Coupled Wheels, Ft.	Coupled Wheels, Ins.	Steam Pressure, Pounds Square Inch. a	Heating Surface, Total Square Feet.	Grate Area, Square Feet.	Weight, Tons, Engine Only.
North Eastern (England)	North British Loco. Co., Ltd.	4–4–2 S_3	Schmidt	16½ x 26 (3)	6	10	160	2,509	27.	77
North Eastern (England)	North British Loco. Co., Ltd.	4–4–2 S_3	Schmidt	15½ x 26	6	10	180	2,340	27.	76¾
Great Central (England)	Railway Works.	2–8–0	Robinson	21 x 26	4	8	170	2,009	26.	72
Northern (France)	Railway Works.	4–6–4 C_4	Schmidt	17⅝ x 25⅝ / 24⅝ x 29⅜	6	8	227	4,158	46.	99
Austrian State	Floridsdorf Co.	2–10–0 C_4	Schmidt	17¾ x 26¾ / 29⅞ x 26¾	4	9	235	3,186	53.8	94½
A. T. & S. F. R.R. (U. S. A.)	Baldwin Works.	2–10–10–2 C_4	Jacobs	28 x 32 / 38 x 32	4	9	225	8,897	81.9	275
Chekiang (China)	Berlin Engineering Works.	4–4–0		18⅛ x 23⅝	5	0	170	1,260	24.7	45½
North Stafford (England)	Railway Works.	4–4–2 T	Schmidt	20 x 26	6	0	160	1,281	21.	68
Great Western (England)	Railway Works.	2–6–0	Swindon	18½ x 30	5	8	200	1,566	20.5	62
Antioguia (Colombia)	Borsig Works.	2–6–0 D	Schmidt	14²/₅ x 20	3	6	170	1,120	24.	27
Great Eastern (England)	Railway Works.	4–6–0	Schmidt	20 x 28	6	6	180	1,919	26.5	64
L. & S. W. Ry. (England)	Railway Works.	4–6–0 S_4		15 x 26 (4)	6	7	200	1,920	31.5	76
Northern (Spain)	Hannover Engineering Works.	4–6–0 C_4	Schmidt	15⅝ x 25⅝ / 23⅜ x 25⅝	5	10	170	.....	.....	69
Argentine Northern	Borsig Works.	4–6–0 F		17⅜ x 24¾	5	3	170	1,404	23.5	44½
L. N. W. Ry. (England)	Railway Works.	4–6–2 T	Schmidt	20 x 26	5	8½	175	1,333	23.9	77
Great Central (England)	Railway Works.	4–6–2 T	Schmidt	20 x 26	5	7	165	1,649	21.	86
Sao Paulo (Brazil)	North British Loco. Co., Ltd.	4–6–2 G	Schmidt	21½ x 26	5	6	200	2,029	28.5	80½
Italian State Ry.	Ernesto Breda.	4–6–2 S_4	Schmidt	18 x 27½ (4)	6	8	170	2,990	37.8	86
B. & O. R.R. (U. S. A.)	Baldwin Works.	4–6–2		24 x 32	6	2	205	5,017	70.	117
South African Government	North British Loco. Co., Ltd.	4–8–2 B	Schmidt	22½ x 26	4	3	180	3,139	40.	91¾
C. & O. R.R. (U. S. A.)	American Locomotive Co.	4–8–2	Schmidt	29 x 28	5	2	180	5,076	66.7	147
Union Pacific (U. S. A.)	Baldwin Works.	2–8–2		26 x 28	5	3	200	5,527	70.	123
C. & O. R.R. (U. S. A.)	American Locomotive Co.	2–8–2	Schmidt	29 x 28	4	8	170	5,124	66.7	140
West Australian Ry.	Beyer, Peacock & Co.	2–6–6–2 A B		12½ x 20 (4)	3	3	175	1,340	22.6	66½
Mexican Ry.	Vulcan Foundry Co.	0–6–6–0 A T		19 x 25 (4)	4	0	185	2,984	47.7	138
A. T. & S. F. R.R. (U. S. A.)	Baldwin Works.	2–6–6–2 A C M	Jacobs	24 x 28 / 38 x 28	5	9	220	5,176	63.	170½
Southern Pacific (U. S. A.)	Baldwin Works.	2–6–6–2 A C M		25 x 28 / 38 x 28	5	3	200	7,117	70.	172
B. & O. R.R. (U. S. A.)	American Locomotive Co.	0–8–8–0 A C M	Schmidt	26 x 32 / 41 x 32	4	8	210	6,529	99.9	209

Recent Railway Mechanical Patents

LOCOMOTIVE STOKER TRANSFER MECHANISM.

1,035,162—David F. Crawford, Pittsburgh, Pa.

This is an apparatus for supplying coal to a locomotive fire-box. It consists of a piston for discharging the coal into the fire-box, a rock shaft, a crank arm thereon, for operating the piston, a tender provided with a discharge passage, a chute with its rear end in position to receive the discharge from said passage and its front end in position to discharge to the said piston, a feed piston working longitudinally of the rear end of the chute for giving the coal its preliminary forward movement, reciprocatory forwarding means arranged along the chute for giving the coal a step by step movement therethrough, a second crank on the rock shaft, of greater length than the first crank arm for operating the forwarding means, and a connection from the first mentioned piston to the feed piston whereby they are operated in unison with a stroke less than that of the forwarding means.

CAST-STEEL UNDERFRAME FOR CARS.

1,035,423—Clarence H. Howard, St. Louis, Mo., assignor to Locomotive Tender Frame Company, St. Louis, Mo.

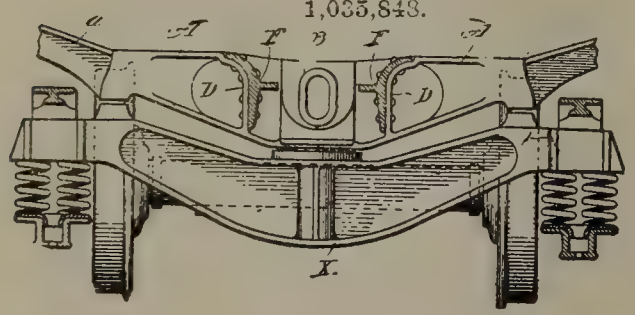
This is a cast steel underframe. It consists of bolsters and longitudinal members integrally connected to said bolsters, said longitudinal members having flanges at their upper and lower edges on one side only throughout part of their length and on both sides throughout part of their length.

SPARK EXTINGUISHER.

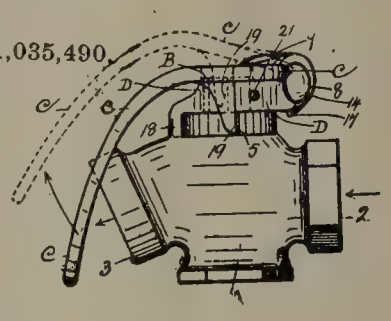
1,035,423—Jean-Baptiste Victor Dallemagne, Paris, France.

This is a spark extinguishing device for locomotives. It consists of a vertically arranged conduit through which the products of combustion pass from the bottom upwardly, of a helically arranged spiral blade located within the conduit and substantially in contact with the walls thereof, said blade comprising smooth, cooling sections progressively offset from each other in the direction of the axis of the helix, said sections being connected by vertically disposed cinder arresting walls extending parallel with said axis.

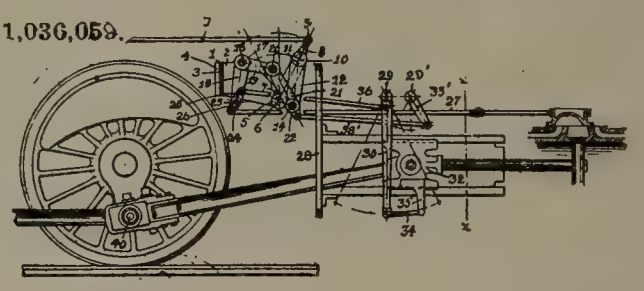
1,035,848.



1,035,490.



1,036,059.



UNDERFRAME FOR CARS.

1,035,848—William P. Bettendorf, deceased, Bettendorf, Iowa, by Joseph W. Bettendorf, administrator. Davenport, Iowa.

An underframe consisting of a center-sill made from a single integral I-beam, the web connecting the flanges of which is horizontally disposed and the upper flanges of which are flared outward.

HANDLE FOR AIR-BRAKE VALVES FOR RAILWAY CARS.

1,035,490—Frederick R. L. Stott and Thomas Crossen, Hamilton, Ont.

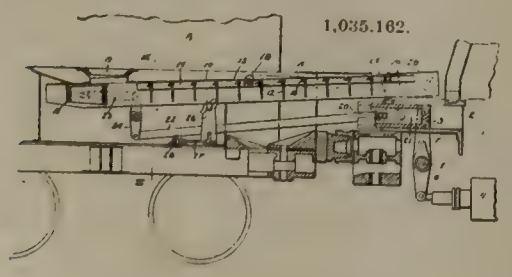
An air brake valve, consisting of a casing having separated shoulders, of a rotatable valve in the casing which is provided with a shank, a key secured to the shank and provided with a member adapted to play between and to be limited in its movement by the shoulders aforesaid, said key being provided at one side of its connection with the shank with a cylindrical casing, a handle pivoted to the key, a torsion spring contained within the cylindrical casing and engaged therewith and with the handle and adapted to hold the handle down on the key, said spring being housed and protected by the cylindrical casing, and means on the handle adapted to engage the shoulders.

REVERSIBLE VARIABLE CUT-OFF VALVE GEAR.

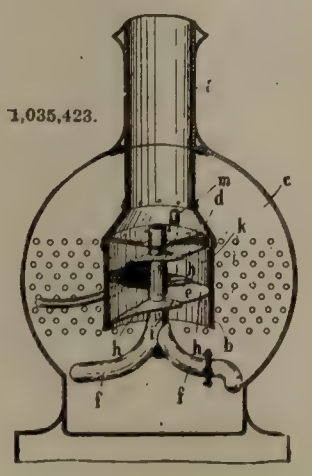
1,035,490—Abner D. Baker, Swanton, Ohio.

A reversible variable cut-off valve gear for locomotives. It consists of a valve gear for each engine comprising a fixed support, a movable support mounted on the fixed support, a radius rocker having a rocker pivot journaled on the movable support and adjustable thereby through an arc, a bell crank journaled on the fixed support, a link connected to one arm of the bell crank and to the radius rocker at a radius from its rocker pivot equal to the radius of the arc of adjustment of the rocker pivot, and means to jointly adjust the movable supports in parallel positions, means connecting the link rod of each gear to the cross head of the other engine, and adapting said cross head to oscillate the radius rocker and bell crank, and means connecting the other arm of the bell crank with the valve stem and with the cross head of its own engine, and adapting the bell crank and cross head of each engine to both jointly and severally reciprocate the valve of the engine.

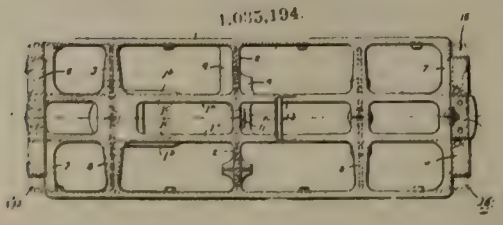
1,035,162.



1,035,423.



1,035,194.



STRUCTURES.

The Chicago, Milwaukee & St. Paul Ry. has commenced work on the construction of a 26-stall roundhouse at Perry, Ia.

The Chicago & Alton R. R., it is reported, is considering the construction of new yards to be opened at Bridgeport, Ill., for passenger equipment storage and also a new roundhouse. In a short time the yards at Brighton Park must be abandoned, due to track elevation. The freight trains will be handled at Glenn, excepting the fast freights, while the passenger equipment yards now at Brighton will go to the new yards at Bridgeport. The company has secured land on which a new roundhouse and coach tracks will be built and work will likely commence this fall or next spring.

The St. Louis & San Francisco R. R., it is reported, has awarded a contract to the Anchor Lumber Co., Victoria, Tex., for the construction of a roundhouse and water service plant at Victoria.

The Pennsylvania R. R., it is stated, has by a bill signed by President Taft, been granted permission to construct a railroad bridge across the Delaware river, at a point about two miles below Trenton, N. J.

The Northwestern Pacific R. R., it is reported, has awarded a contract to the Mercer-Fraser Co., 16 California street, San Francisco, Cal., at approximately $500,000, for the construction of all the masonry work, arches and bridges, on its right of way between Island Mountain tunnel and Fort Seward.

The Cincinnati, Fleminsburg & Southeastern R. R. has awarded the contract for the erection of a passenger station at Fleminsburg, Ky.

The Rock Island, Farwell & Gulf Ry., it is stated, will construct shops at Big Spring, Tex.

The Western Maryland Ry. has awarded a contract to the Willard E. Harn Co., Baltimore, Md., for constructing a one-story brick passenger station at Roslyn, Md.

The New York, New Haven & Hartford R. R. has awarded a contract to C. W. Murdock, of New Haven, Conn., for the construction of a brick locomotive shop at Readville, Mass. The contract price is said to be $35,000.

The Albany Passenger Terminal Co., Albany, Ga., is reported to have the authority to issue $110,000 of bonds to build a union station in Albany.

The Atchison, Topeka & Santa Fe. Ry., is reported to have recently authorized the expenditure of $189,011 on the Northern, Southern and Beaumont division and on the Texas & Gulf Ry. Quite a number of building improvements will be effected.

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Published at the World's Greatest Railway Center
Established 1878

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M. C. B. SPECIAL LETTER BALLOT.

A special letter ballot was recently sent out to the members of the Master Car Builders' Association, from the secretary's office. Two questions on car interchange were to be voted upon: The abrogation of penalty defects and the suggested addition of ten per cent to the present detail listing of repair bills. These questions have excited a great deal of interest among the members owing to the importance of the changes in the present system which would follow adoption.

The replies received were unanimously in the affirmative on both questions. The executive committee then took up the subject of a proper revision of the book of rules and it was decided not to reprint them, but to cover the changes by means of a sticker which will be sent out for insertion in the existing books. The revision is scheduled to go into effect on November 1, 1912.

THE SMALL SHOP.

The problem of the efficient handling of repair work is one of the big problems of the mechanical department, and the distribution and location of repair facilities is one of the factors which may greatly help or hinder the efficiency of such work. It is interesting to note the trend of present day practice in this regard. The practice in years past has been to concentrate repair facilities of a road at one or two large shops located at central points and to give terminal roundhouses very little or no equipment for repairs. It was necessary to send an engine to the shop of the road for the lightest repairs, necessitating its absence from service for a considerable period of time. However railways have expanded into railway systems, roads have stretched from one state to half a dozen, and amount of rolling stock per mile of road has been greatly increased. Railways now realize that time is money, that to earn the greatest return on the investment, a locomotive must be kept in service until it is scrapped, with as little loss of time as possible during the period of its existence.

The small terminal shop is the outgrowth of all this and its importance is increasing yearly. Most roundhouses recently built have shops which are well equipped for taking care of all but the heaviest repairs, and their efficiency is being generally recognized in eliminating a large amount of time which would otherwise be lost in sending the locomotive to the main shop. There is a tendency on some roads to shift all the poor and used machinery from the larger shop and this is a feature which cannot help but work to the detriment of the small shop. Such machines should be kept at the main shop as it only has the facilities and reserve to provide for an emergency, which the small shop has not. The small shop should be equipped with good new tools if it is to prove its value.

One of the customary ways of locating the machine shop is in a building adjacent to the outer circle, and which contains also the boiler and engine rooms. The introduction of motor drive and heavy machine tools has done much towards the economical operation of such a shop.

There is also the personal element to be considered in the operation of the small shop. Although our large shop

and large organizations are supposed to be highly efficient, the introduction of the personal interest feature is one of the hardest problems in connection with such an organization. The small shop on account of its localization and its comparatively few employes, gives its workers more individuality and more interest in their work, at the same time not neglecting the realization that they are a part of a great system. The engine man is also brought close to the repair shop and can render assistance which he can not when the engine is sent to the main shop.

The large main shop we must always have, of course, and its importance is by no means minimized. But it is becoming more and more a place for heavy work and general shopping of engines. The growth of the small shop has also strengthened the main shop by making it more creative. Quite a number of roads are successfully building their own locomotives at their large shops and whether or not the growth of the small shop will tend to promote this condition of affairs remains to be seen. Certain it is however. that the growth of the small shop has had its effect on the design and scope of the large shop, such as effecting the introduction of heavier cranes, the elimination of balconies and the introduction of a building construction with improved natural lighting facilities. So the small shop has done much, both for itself and its parent shop, and will continue to grow in strength and numbers.

EDUCATING THE MAN HIGHER UP.

A great deal is said about educating the man below, but we hear little about educating the man higher up. This is a much more delicate proposition but just as essential nevertheless. By educating the man higher up, we do not mean that his knowledge or authority is to be questioned because usually he knows the path over which he has come pretty well. But we never stand still; conditions are constantly changing and although he can decide questions wisely because of his experience, he cannot be thoroughly familiar with changing conditions and details. Owing to new conditions he may not realize the importance of certain details and he cannot keep in touch with all the opportunities of the man below him.

The man who makes the most of his position is he who educates the man above, that is, he is thoroughly familiar with his own work and when he advances an opinion, he is able to back it with facts and figures. Most men are willing to be shown if it can be proven to them in black and white. When you have a new method in mind, you should be thoroughly familiar with it and have looked at it from all sides in order that you can lay the whole proposition before your superior in a few words and can give him every bit of information he desires.

At the recent Traveling Engineers' convention one road foreman said that he did not get much encouragement from his mechanical department head on the question of fuel economy. It is possible that his superior ran an engine in the days when no one thought of fuel economy, and has not seen the importance of the subject. That road foreman, by carefully studying the subject and obtaining some accurate cost figures, should be able to bring the matter to the attention of his superior in such a way that he would see the logic of helping his road foreman in his efforts. If the road foreman did not convince him the first time, he should wait until he had obtained additional data, and again present it. Nearly every man is anxious to help a subordinate who he sees is interested in the welfare of the department and who can show his interest in a logical way. The department head who is not, will not stay there long.

Your superior may not take kindly to your suggestion the first time. Then think of the objections he has raised and bring him information covering them. You may not convince him the first time, but continue to bring him information in a respectful way and if your position is sound, he will, in time see your viewpoint. Or it may be possible that in going into the matter deeper, you yourself will see some strong objection. In that case you are the better for it. In reality, educating the man higher up, results in educating yourself.

TENDER DERAILMENTS.

The American Railway Master Mechanics' Association has in the past few years, shown its realization of the necessity for advancement in tender design by giving the subject considerable attention. The latest types of locomotives, however, are fitted with tenders which are giving as much or greater trouble than those of older design. There are so many difficulties to be overcome in the proper design of a tender of the size required by the larger engines now in use, that it is not surprising that trouble is experienced. Usually a tender derailment results in nothing more serious than delayed traffic and perhaps for this reason the subject has not excited so much interest as would be the case if the results were ordinarily more serious. No doubt the high center of gravity of modern tenders, coupled with the conditions of a somewhat unstable load and short wheel base, not met with in the construction of ordinary passenger or freight cars, are to be charged with the seemingly unaccountable action of the former.

When, as is most frequently the case, in accidents of this kind, the tender is the only car in the train which is derailed, it is difficult to place the blame upon track irregularities. There is room for considerable difference of opinion as to just how much a track may be out of surface, or alignment before it should be considered unsafe for certain speeds. Most derailments are caused, directly or indirectly, by track imperfections. Tracks, however, cannot be made to remain absolutely perfect and rolling stock must be expected to operate safely on other than absolutely perfect track.

In several recent cases of tender derailment it was found that the truck springs were defective. In one case it was found that these springs had been broken previously to the accident. In this instance the track at the point of derailment was found to have a sag in one rail, of three-eights of an inch in a distance of fifteen feet. In almost any railway organization the maintenance of way department could not be held responsible for a derailment on account of as slight an irregularity as this. Nevertheless it was the irregularity, together with the broken spring, which caused the

accident and the blame fell upon the man responsible for the terminal inspection of that locomotive. The ascribing of a tender derailment to a broken truck spring may appear far fetched, but the connection is easily described. With the weight of the tender solidly on the journals on one side of the truck, an enormous load must be taken care of by the journals on the side in question at the time of reaction from low points in the rail or when a high point is struck suddenly. The result is a very great retardation of the wheels on that side while those on the opposite side are rolling with greater freedom. As the truck is pulled from the center, a severe twist is the result, and derailment is more or less certain, according to the severity of this twisting action. It is perfectly possible to find irregularities in the most carefully maintained track, of sufficient magnitude to cause derailment under these conditions. Attention must be given to the necessity for the greatest of freedom from sudden reactions between the truck journals and the load in tender design. It is possible that radical changes are necessary to secure reasonable security from tender derailments.

BRITISH LOCOMOTIVE DEVELOPMENTS.

By Thomas Reece.

An interesting chapter in the history of the London and North-Western Railway is closed with the scrapping of the last of the three-cylindered compound passenger locomotives belonging to that line. When John Ramsbottom was appointed chief mechanical engineer at Crewe in the late fifties he found a vast amount of work to do in standardizing and modernizing the locomotives turned out from those works. Various lines having been amalgamated, there were three locomotive works on the system—at Wolverton, Crewe and Longsight. The last-named had been under Mr. Ramsbottom's supervision and engines belonging to the old Manchester and Birmingham lines were repaired there. On moving to Crewe, Mr. Ramsbottom reduced Longsight to the position of an engine shed where certain breakdown repairs could be made, the heavy work being done at Crewe, and he set to work to build heavier and stronger engines than had existed before on the northern section of the line. For some years after this Mr. McConnel, the locomotive engineer for the southern division, continued to build engines at Wolverton, but later he retired, and Wolverton works were converted into carriage building works.

Mr. Ramsbottom began by building the noted DX class of goods engine. These were of the six-coupled 0-6-0 type, which is so common today in larger engines. The Crewe goods engine had previously only been four-coupled. Turning his attention to passenger traffic next, Mr. Ramsbottom built the first of this four-coupled Samson engines. This was of the 2-4-0 type, and driving wheels from some out-of-date single passenger engines were used in the construction of it and some subsequent engines. Immediately before this, however, in 1859, Mr. Ramsbottom designed and built a new class of express passenger engine, with 7 ft. 6 in. single driving wheels, and they were known as the Problem or Lady of the Lake class. They were very economical and free-running engines, and became world-famous for their runs with the Irish mail and with other expresses also between Crewe and Euston. It was the Samson class, however, which led the way for the modern type of engine on the London and North-Western. Mr. Ramsbottom, finding these engines a success for heavier trains, built some larger engines of the same class, and Mr. Webb, who succeeded him, in December, 1874, brought out a still heavier and more powerful class known as the Jumbo or Precedent class. These were still of the 2-4-0 type and one of them, the Charles Dickens, became especially noted in Manchester, and is still in active service. The weight of the trains increasing, Mr. Webb in 1882 built his first three-cylindered compound engine, and appropriately named it Experiment. Though at first sight it appeared to be of the 2-4-0 wheel arrangement, as a matter of fact none of the wheels was coupled. The single inside-low pressure cylinder drove the leading pair of driving wheels, and the two outside high-pressure cylinders drove the trailing pair of driving wheels. Thirty of these engines were built, and finding them too light, 40 of a heavier class, the Dreadnoughts, followed.

A storm of criticism raged round Mr. Webb at the time as to the behavior of these engines, and events proved that most of the criticism was justified. However, unmoved, Mr. Webb built ten more of a slightly larger size, the Teutonic class, of which one engine, the Jeanie Deans, attained notoriety by its daily run with the 2 p. m. corridor express from Euston. Mr. Webb next built the Greater Britain class of compounds. These were still three-cylindered, but they had very long boilers with a combustion chamber half-way along them—another ill-fated experiment. The long boilers necessitated an extra pair of carrying or trailing wheels under the foot-plate, so that the wheel arrangement now became 2-2-2-2, as the four driving wheels were still uncoupled. Ten of these Greater Britain engines were built, and ten more with smaller wheels, known as the John Hick class. By this time Mr. Webb had realized that the non-coupled compound engine was not a success, especially as he had been building some three-cylindered eight-coupled mineral engines. He abandoned the three-cylindered type of passenger engines and began to build the four-cylindered four-coupled compound express engines of the Diamond Jubilee class. On Mr. Whale succeeding Mr. Webb, compounding was dropped, and Mr. Whale and Mr. Bowen Cooke steadily scrapped the five classes of three-cylindered passenger engines until the last, the Richard Arkwright, has now been removed from the line. The three-cylindered passenger compounds have been replaced by Mr. Whale's four-coupled 4-4-0 Precursor class and six-coupled 4-6-0 Experiment class. Mr. Bowen Cooke has since added the superheated engines of both these classes known as the George V. and Prince of Wales classes. Simple superheated engines have thus become the standard for express service on the London and North-Western in place of compounds, and the goods service is also gradually being so altered.

Locomotives now being constructed here include 12 for service on the London, Tilbury and Southend Railway, four of which will be of the 0-6-2 wheel arrangement, while the remaining eight will be large tank-engines of the 4-6-4 type,

and will form the first Baltic type standard-gauge tank-engines employed in Great Britain for main line service. The latter engines will have coupled wheels, 6 ft. 3 in. in diameter and leading and trailing wheels 3 ft. 1 in. in diameter. The wheel base of the leading and trailing bogies will be 6 ft. 6 in. in each case, and the centers of the bogies will be placed 32 ft. 4½ ins. apart. The driving wheel base will be 13 ft. 10 in. and the total wheel base 38 ft. 10½ in. The cylinders will be 20 in. by 26 in. stroke. The boiler will have a working pressure of 160 pounds per square inch, and the diameter will be 5 ft., the center line being pitched 8 ft. 4½ in. from rail level. The total heating surface will be 1,446 sq. ft., to which the tubes will contribute 1,305 sq. ft. and the firebox the remaining 141 sq. ft. The fire grate area will be 25 sq. ft. These engines will have a tank capacity of 2,200 gallons of water and space in the bunkers for 6,720 pounds of coal. The fittings include Schmidt's superheater, mechanical lubricators, and Crosby safety valves. The length over buffers is 47 ft. 8 in.

The advantages which are claimed for internal combustion engines when employed in railway work are being made the subjects of much discussion in Great Britain at the present time. It is recognized that one useful feature of the internal combustion engine is the very substantial economy in fuel. The average steam locomotive will burn some 4 pounds of coal per hour per h. p. against 1 pound of oil fuel. On the other hand the steam engine is at present the simpler to use and less liable to mechanical derangement. Lowness of initial cost, simplicity of mechanism, easy control and reversal, steady tractive effort and small depreciation and repair costs are among its many advantages. The internal combustion engine exponents in reply are well in the field with claims for economy in fuel, small water requirements, smoothest possible tractive effort, with a high starting acceleration, and simplicity of control with a suitable starting and transmission gear.

The necessity of providing a special starting and transmission mechanism arises from the relatively poor flexibility of the oil engine. An oil engine will run excellently from say 1,000 down to 100 to 200 r. p. m., but is liable to stop altogether if run at a lower speed. This means that it cannot be in permanent connection with the driving wheels of its locomotive, else it would not start. To remedy this defect special mechanism, of a mechanical or other nature, is needed. In steam locomotives this direct connection is feasible, and it certainly affords the simplest arrangement. The reason why slow speeds are not possible with oil engines is that the explosive thrust on the connecting-rod is too intermittent to carry the engine round during the intervals between the pulses unless the speed is fast enough for it to be assisted across these intervals by its own momentum. Moreover, the temperature in the gases in an internal combustion engine is very high, and a slow speed gives a longer time for cooling and for consequent loss of explosive force. The use of an auxiliary device for transmitting the power to the wheels enables all these difficulties to be avoided, and it sometimes has the advantage of introducing other improvements, partly or wholly compensating for the additional complication involved.

Much attention has lately been paid to the possibilities of the Diesel oil engine. So far it has not been used for locomotive purposes on road or rail, but Dr. Diesel is at work with Messrs. Sulzer Brothers, at Winterthur, and Herr Adolph Klose, of Berlin, on a 1,000 to 1,200 h. p. Diesel locomotive. Steam locomotives have, of course, been made of much larger sizes, and the above engine will not, therefore, improve on its immediate predecessors in this respect, but it may be expected to show very large economies in fuel consumption. The Diesel engine proposed for this work is of the two-stroke cycle, four-cylinder type, having its cylinders arranged in pairs at an angle of 90 deg. The engine is directly geared to the driving wheels, and does not transform its power electrically. An auxiliary engine drives air pumps for giving increased torque when starting or when climbing a grade. The whole is expected to weigh about 190,400 pounds. It will be seen that this locomotive gives the most direct form of challenge to the steam locomotive.

THE WABASH has a traveling school of instruction for engine men consisting of a car supplied with lubricator, injector, air brake, electric headlight, car heating, sanding, valve motion and fire door apparatus together with a stereopticon for lecturing purposes. The instructor is a locomotive engineer of ten years' standing. The car is routed to different points and matters are so arranged that enginemen can all attend from seven to ten days. This school of instruction is organized, having officers and a board of directors, and the purpose as stated in the constitution is to combine the interests of locomotive engineers and firemen, and to improve their knowledge of the operation of engines.

ONE OF THE OUTGROWTHS of the Educational Bureau of the Illinois Central R. R. is the establishment of what is known as "Partial Time Vocational Education." In the shops at McComb, Miss., there are forty-one regular apprentices and, augmenting these, with the co-operation of the public schools of that city, an arrangement has been effected whereby twenty-five of the students who have reached the high-school course will divide their time between the class room and the shops; that is, these students, each two representing one apprentice, will be received in the shop and trained in such crafts as they may select, spending one-half of each day in the class room and the other half in the shop, alternating morning and afternoon work so that in their literary work every study may be cared for, each student receiving the regular apprentice boy's pay per hour.

This co-operative agreement carries vocational training along with their high-school education and equips the boys for life's battle about the time, or shortly after, they receive their high-school diplomas. Under the arrangement each of the partial time apprentices agrees to continue his work in the shops until he has reached the proficiency of journeyman.

Negotiations are now in progress with public school officials in other cities where large Illinois Central shops are located, and the "partial time vocational education" will soon be established in those shops on the same basis as in effect at McComb, Miss.

THE MISSOURI PACIFIC system, on the first of August, turned over the management of its hospitals to its employees. These consist of large hospitals at St. Louis, Kansas City and Little Rock, together with arrangements at thirty other points along the system. All employees and officers pay a small monthly assessment, based on their salaries. There will be a board of managers selected one from each of the following departments: Train, Engine and Yard Service, Shop, Roundhouse and Repair Yards, Employees on Maintenance of Way and Structure, Telegraphers, Office and Station Employees, Operating Department, Law Department and Accounting Department. The road will handle all accounts and funds free of charge.

Locomotive Fuel Consumption

Effect of Gradient, Alignment, Operating and Other Conditions, on Locomotive Fuel Consumption

By A. K. Shurtleff, Office Engr., C., R. I. & P. Ry.

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The largest primary account in the operating cost of the average railroad is "Fuel for road locomotives." Locomotive fuel consumption can be divided as follows:

1. Fuel used for work.
2. Fuel used account of leakage of water and steam, and for steam used for brakes, whistling, etc.
3. Fuel used for re-evaporation due to radiation.
4. Fuel used at engine houses "firing up," etc.

The tables in the American Railway Engineering Association Manual of 1911 provide for fuel used under the first three headings during the period of maximum effort.

Two tons of coal per hour is the average that can be properly hand-fired by a single fireman in a modern freight locomotive, through the long periods of maintained effort required in making the schedule with the maximum train. The tables referred to, however, provide for any practical amount of fuel consumption, but it is rare even with a relief fireman that over five thousand pounds of coal per hour will be fired during the period of maximum work by a freight locomotive.

No accurate mathematical method can be fixed for estimating locomotive fuel consumption. Details of construction, condition of the locomotive and the "personal equation" of both the engineer and fireman introduce variables which materially affect the question. Single tests may show what might be expected under like conditions, but for the student of economics in railway location or operation, averages must be considered. The personal equation of the fireman probably is the greatest variable, and for the same man will vary widely on different trips.

No economic study can be of value that does not consider the average efficiency of the laborer.

The fuel used by locomotives while drifting or at rest is a material amount of the total consumption. At the 1904 convention of the American Master Mechanics' Association, some valuable data was presented covering twenty-one tests over an engine district on the Atchison, Topeka & Santa Fe, and twenty-four tests on the Norfolk & Western.

From this data the accompanying tables covering fuel used at rest was obtained. The tables are arranged in the order of delayed time for each locomotive and a study of the coal used as compared with the time delayed will show the variable character of the personal equation and the necessity of following the rule of averages in estimating economies.

A., T. & S. F. Test Trains. Test Trip 112.74 Miles.
Coal 11,000 B. T. U.

Loc. No.	Sq. Ft. H.S.	Delays Hrs.Min.	—Used at Delays— Lbs. Coal	Lbs. Water
606	2,626	1:17	735	1,865
606	2,626	1:20	377	3,000
606	2,626	1:52	1,086	1,487
606	2,626	3:05	1,800	1,991
606	2,626	3:52	1,186	1,159
601	2,626	2:08	585	2,053
601	2,626	2:44	1,110	2,525
601	2,626	3:42	1,290	2,458
601	2,626	3:55	1,260	3,981
601	2,626	5:42	1,590	1,604
1051	3,738	1:03	615	1,195
1051	3,738	1:05	660	3,767
1051	3,738	1:11	1,020	1,393
1051	3,738	1:35	770	1,758
1051	3,738	3:25	1,255	1,254
565	3,666	3:15	1,155	2,293
175	1,560	1:06	490	1,027
175	1,560	1:17	260	1,022
175	1,560	2:25	980	731
175	1,560	2:44	610	889
175	1,560	3:19	650	2,031
Totals	56,416	52:02	19,484	39,483

Average heating surface per test trip..... 2,686 sq. ft.
Coal used per hour delay, total..... 374.5 lbs.
Per 1,000 ft. H.S..... 139.4 lbs.
Water used per hour delay, total..... 758.8 lbs.
Per 1,000 ft. H.S..... 282 lbs.

Coal used per trip "firing up" at engine houses, average of 15 tests.....515 lbs. per 1,000 sq. ft. H. S.

N. & W. Test Trains. Test Trip 99.7 Miles.
Coal 14,000 B. T. U.

Loc. No.	Sq. Ft. H.S.	Delays Hrs.Min.	Coal Used at Delays
923	2,474	1:43	1,400
923	2,474	2:36	500
923	2,474	2:36	925
923	2,474	2:40	1,800
923	2,474	4:14	800
923	2,474	4:38	1,000
923	2,474	5:20	700
923	2,474	6:23	2,000
923	2,474	8:37	600
923	2,474	8:48	2,300
923	2,474	10:23	1,838
923	2,474	12:42	3,800
839	2,415	1:29	1,175
839	2,415	1:55	300
839	2,415	2:15	400
839	2,415	2:23	500
839	2,415	2:44	900
839	2,415	3:20	300
839	2,415	3:53	800
839	2,415	4:41	600
839	2,415	5:00	1,000
839	2,415	5:41	1,000
839	2,415	5:47	900
839	2,415	6:00	1,300
Totals	58,668	115:48	26,838

Average heating surface per test trip..... 2,445 sq. ft.
Coal used per hour delay, total..... 232 lbs.
Per 1,000 ft. H.S..... 94.8 lbs.

Coal used per trip firing up at engine houses, average, 24 tests.....501 lbs. per 1,000 sq. ft. H. S.

The fuel loss by radiation depends on the temperature of outside atmosphere, area of boiler exposed and quantity and quality of boiler covering. The exposed area varies and is not one of the items given with locomotive dimensions. With modern locomotives there is from 4.75 to 5.75 square feet of exposed area to one square foot of heating surface. The proportion of this outside area insulated against transmission of heat varies. Evaporation is from heating surface, and owing to the variables and undetermined area of boilers exposed, the losses will be based on heating surface.

The heat loss from radiation is the total loss when locomotive is not working less the loss due to leakage and use of steam and water for other purpose than work.

In the A., T. & S. F. tests, it would require 34.7 pounds of 11,000 B. T. U. coal per 1,000 square feet of H.S. to evaporate the 282 pounds of water used per hour while idle from a feed water temperature of 65 degrees to a boiler pressure of 200 pounds.

The N. & W. tests do not give the water and steam losses while at rest. In 97 tests at the St. Louis Exposition testing plant the average steam loss per hour per 1,000 square feet of heating surface was 151 pounds. These locomotives were probably in as good or better condition than the average road locomotive and the N. & W. locomotives can be considered as losing at least this amount of water and steam.

There would be required 14.6 pounds of 14,000 B. T. U. coal per 1,000 square feet H.S. to evaporate this quantity of water wasted.

A fair average for this loss of heat due to other uses of steam and leakage can be based on 200 pounds loss an hour per 1,000 square feet of heating surface.

The coal loss from radiation during delays in these tests can then be estimated as follows:

A., T. & S. F.: 139.4 — 34.7 = 104.7 lbs. per 1,000 ft. H.S.

N. & W.: 94.8 — 14.6 = 80.2 lbs. per 1,000 ft. H.S.

Mr. Henderson, in "Locomotive Operation," states that in tests with one locomotive he found the loss from radiation at 28 M. P. H. velocity double the loss with locomotive standing.

Practically all drifting is done on gradients, and at a velocity exceeding this; therefore no great error will occur in basing this loss while drifting at double the amount standing.

The fuel used in the tests at engine houses firing up does not seem consistent with the total heat units when comparing the two series of tests. This is due to many causes. Engine-house practice varies widely on different roads and in the houses of the same road. Probably the least study in reduction of fuel wastes is given to fuel used while the engines are at terminals.

The following table is arranged, based on results secured in these tests and the assumption that evaporation is proportional to the total heat units in the coal, except in the case of coal "firing up," which, until better methods obtain, is based on the amount actually used in the tests. In proportioning the fuel on the B. T. U. contained, the fact that ash and other components of the fuel vary must be neglected along with the other variables.

Approximate Pounds Coal Burned per 1,000 Sq. Ft. Heating Surface, Locomotive Not Working.

B. T. U. Per Lb. Coal	Per Trip Firing Up	Radiation, Leakage, Etc. Per Hour	
		Standing	Drifting
10,000	520	145	263
11,000	515	132	239
12,000	510	121	219
13,000	505	111	202
14,000	500	103	188
15,000	495	97	175

As a test of the value of the above table in approximating fuel consumption the following data is given covering one week's actual operation on a division of three engine districts. The data given is actual except that time drifting is estimated by platting a "time diagram," and this deducted from actual running time to get time "working."

Total freight locomotive miles		27,575
Total freight locomotive trips		220
Heating surface per locomotive		2,905
Hours delay (standing)		855.4
Hours drifting	408.2	
Hours working	1,312.6	
Total hours running time		1,720.8

Average value of coal, 11,000 B. T. U.

Estimated Fuel Used.

	Pounds
Firing up, 220 trips @ 1,496 lbs	329,120
Standing, 855.4 hours @ 383.46	328.012
Drifting, 408.2 hours @ 694.3	283,413
Working, 1,312.6 hours @ 4,000	5,250,400
Total estimate	6,190,945

Estimate per freight locomotive mile, 224.5 lbs.

The actual cost used per freight locomotive mile on this division during the month from which this data was taken was 224.1 pounds. It cannot be expected that as close an approximation can be obtained in all cases, but this method can be applied to different locations or different divisions and a reasonable comparison made of the relative fuel economy, providing the data to estimate the same is at hand.

The table covering the fuel used is of little value except as information to the student of economics unless a method be provided for estimating the various components of the total time over a district. From data secured on two western roads, single track divisions, and covering two weeks' time on seven engine districts of one line and one week's time on three engine districts of the other, the average time taken for orders, coaling and watering locomotives was one-half minute per engine per mile of district. The total number of meeting points and points of passing by superior trains was 8,709, and the average time delay for each freight train was 15.9 minutes for each of such points. On the lighter traffic districts where time was ample, more time was taken than above at meeting or passing points.

A safe figure for estimating the delay time is ½ minute per engine mile plus 15 minutes for each train met or train in same direction allowed to pass.

The number of such points can be closely approximated by estimating the number of freight trains required to handle a given traffic, both freight and passenger, and platting the same graphically on a chart similar to those used in making time cards, one side drawn to scale of miles over locomotive district; the other into scale of 24 hours. Where information is not available as to the time trains may reach the district, the total number of trains may be spaced out through the 24 hours. The trains in one direction may be platted in straight lines covering the district in the time of the *desired* schedule. The passenger trains and one freight train in the opposite direction may then be platted and the intersections of the one freight with other trains counted.

With this method, lines representing schedules for the different classes of freight service may be used and the points determined for each class.

The foregoing method refers to single track. On double track only trains in the direction of traffic should be considered.

Running time, divided between time working and drifting, may be estimated by the construction of a time diagram.

The method requires labor, but after preparing the tables suitable for the problems it is possible to plat the speed lines and calculate the time over fifty miles or more of profile per day. The problem in economics of railway operation or location is not solved until reasonable proof has been obtained that the assumed train can move over the district within the allotted time, and on a district with adverse grade, most of which may be controlling and practically all in one direction, or on districts of a very low rate of gradient, the locomotive must be operating at a shortened cutoff to get over the district without overtime. The time taken in the preparation of a set of tables is well spent, and the tables are valuable for many different problems. The time diagram will frequently save the engineer severe criticism and, of far greater importance, will save the railways money in preventing expenditures for improvements that are based on incorrect assumptions.

The Speed Diagram and Its Uses.

The preparation of the data necessary to construct a speed diagram requires, first, that a given locomotive be considered, preferably of modern type, and of good power; second, total weight per car of train be approximately known.

For the purpose of illustrating the methods used in the preparation of data the following locomotive is considered.

Type, 2-8-0; cylinders, 22x30 ins.; drivers, 63 ins.; heating surface, 3,300 sq. ft.; boiler pressure, 200 lbs.; weight (including tender), 173 tons.

Using the methods outlined by the 1911 Manual of the Railway Engineering Association, and considering 4,000

pounds of coal with thermal value of 11,000 B. T. U. as the maximum per hour for maintained effort, this locomotive can supply steam for full cut-off up to a velocity of 5 miles per hour, with a cylinder tractive power at this velocity of 39,000 pounds. The locomotive resistance, excluding head end resistance, will be 2,360 pounds.

This locomotive is a fair average of the modern consolidation type used on nearly all roads of any considerable traffic and the calculated maximum velocity at full cut-off is very close to what is being obtained with simple engines in the large territory in which the available fuel approximates a thermal value of 11,000 B. T. U. per pound. This locomotive burning a higher grade fuel would be able to generate steam to fill the cylinders at full cut-off at a greater velocity than given and the calculations necessary for a speed diagram would produce different results, from the tables presented with this paper, but the methods involved in the calculations would be the same.

Variables enter into the question of train resistance as a careful reading of the text of the Economics Committee report in part 1, volume 2 of the A. R. E. A. proceedings will disclose and as any engineer can testify who has tried to analyze dynamometer records of two districts of widely different character with reference to curvature and character of maintenance of both roadway and equipment. The modern formulae generally adopted for practical purposes consider the resistance per car on level grade as A + B T, in which A and B are constants and T is tons weight of car and contents. The formula given in the 1911 Manual is a compromise between resistance as found on lines of short tangents, large percentage of curvature and gondola cars and that found on lines of very moderate curvature with the bulk of trains composed of box cars. It is probably too high for prairie lines of fair maintenance, as a careful analysis of twelve test trains maintaining uniform speed for considerable distances on tangent and uniform grade, shows an average of several readings not varying far from the formula of "R" per car = 86 + 2.6 T for level grades. No criticism is intended of the formula adopted by the Association, the present idea being to show the variable character of resistance, and that the formula as adopted may be high for some cases and low in others. The running time of a maximum train of empties between the terminals of a district is necessarily greater than required for a train of maximum loads. The reason for this can readily be understood by considering the difference in resistance due to grades for both trains. Any formula that considers the loading of cars will illustrate the point, but in the following the A. R. E. A. formula is used:

Weight of car.....	20 tons	70 tons
Resistance 1% grade.....	565.6 pounds	1,675.6 pounds
Resistance level grade.....	165.6 pounds	275.6 pounds
Per cent "R" on level.....	29.3%	16.5%

Briefly stated, the proportional resistance on the flatter grades for light loads is much greater than for heavier loading and on these flatter grades the train with the concentrated loading can accelerate to and maintain a higher velocity.

The average running time can be estimated by using a figure for resistance that will approximately agree with the average weight per car of train. In the following calcula-

TABLE NO. 1

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HAUL ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED
CARS AND CONTENTS, 1306 TONS, LOCOMOTIVE 173 TONS, TRAIN RESISTANCE, 5.4 LBS.
PER TON FOR VELOCITY 4 MILES TO 35 MILES PER HOUR

VELOCITY MILES PER HOUR	LEVEL GRADE			
	DRAW BAR PULL "P"	TRAIN RESISTANCE "R"	P-R POUNDS	P-R PER TON
START	38980	16978	22002	14.88
1	38512	11754	26758	18.09
2	38043	9142	28901	19.54
3	37574	7836	29738	20.11
4	37104	7052	30052	20.32
5	36634	7052	29582	20.00
6	33328	7052	26276	17.77
7	30567	7052	23515	15.90
8	28259	7052	21207	14.34
9	26324	7052	19272	13.03
10	24669	7052	17617	11.91
11	23221	7052	16169	10.93
12	21870	7052	14818	10.02
13	20577	7052	13525	9.14
14	19345	7052	12293	8.31
15	18168	7052	11116	7.52
16	17041	7052	9989	6.75
17	15992	7052	8940	6.04
18	14985	7052	7933	5.36
19	14082	7052	7030	4.75
20	13179	7052	6127	4.14
21	12334	7052	5282	3.57
22	11561	7052	4509	3.05
23	10869	7052	3817	2.58
24	10197	7052	3145	2.13
25	9617	7052	2565	1.73
26	9074	7052	2022	1.37
27	8565	7052	1513	1.02
28	8103	7052	1051	.71
29	7687	7052	635	.43
30	7298	7052	246	.17
30.67	7052	7052	0	0
31	6932	7052	− 120	−.08
32	6584	7052	− 468	−.32
33	6256	7052	− 796	−.54
34	5954	7052	−1098	−.74
35	5672	7052	−1380	−.93

P= Draw bar pull of locomotive in pounds.
R= Train resistance in pounds.
V_1= Terminal velocity in miles per hour.
V_2= Initial velocity in miles per hour.

(P-R) per ton of train (including locomotive) when positive in value is the net power available for use in overcoming grade resistance at maintained speed. Also represents the power available for acceleration.

(P-R) per ton of train (including locomotive) when negative is the assistance that must be received from descending grades in order to maintain the given velocity. When such assistance is not received it becomes a retarding resistance.

For (P-R) for other than level grades subtract from its value per ton of train for level grades the grade resistance in pounds per ton of train.

The distance in feet required to accelerate from a given velocity to another equals $70(V_1^2-V_2^2)$ divided by the mean of (P-R) per ton of train for the two velocities.

tions 5.4 pounds per ton level resistance is assumed. This would represent an average weight per car of 30.7 tons; according to the formula $R = 86 + 2.6\ T$; 32 tons by the Pennsylvania formula, and 38 tons by the A. R. E. A. formula. The average weight per car of the leading roads of the country varies between 30 and 40 tons.

Tables Nos. 1 to 5 were originally constructed for use on districts having ruling grades from 0.7% to 1%, although they may be used with a considerable degree of accuracy for lighter gradients. The method of using them will be explained later.

Table No. 1, "Locomotive loaded with maximum train for 1% grade," is figured on the maximum at 5 miles per hour. Formerly in calculations of this character 10 miles per hour was the minimum velocity assumed, but common practice in every-day work for dead freight will load the locomotive down to this low velocity on the ruling grades wherever there is sufficient amount of lighter gradients on the district so that the train can cover the same without overtime, unless the traffic be so dense as to call for the stopping and starting of trains on the ruling gradients due to block signals being against them.

This table gives the draw bar power of locomotive from starting up to 35 miles per hour on level grade, the train resistance, and the difference between the two. The difference in resistance represents the power that can be used in accelerating or retarding trains on level grade or in overcoming gradient as explained in the notes on the table.

Tables Nos. 2 and 3 covering distances in stations and decimals passed in accelerating or retarding with locomotive working, are calculated from the formula given on Table No. 1. The distances given for acceleration to each velocity are the sums of the various increments in accelerating from mile to mile, velocities from the starting point, or in case of the heavier grades, from the lowest mile velocity at which a train can be moved. In retarding grades the distances are from an initial velocity of 35 M. P. H. The distance passed over in going from one velocity to another is the difference between the figures shown on the table for the respective velocities.

Table No. 4 covering distances traveled in drifting is calculated on the same principle except that the resistance of train, locomotive resistance and the mean head end resistance are added together, and divided by total weight of train, including locomotive, to get resistance per ton of train. The difference between this and grade resistance gives the power per ton for accelerating or retarding train. The use of the mean head end resistance, while not mathematically correct, creates only a slight error in the tables as it is only a small part of the resistance, and it simplifies the preparation of the table materially.

Platting the speed line closely for any given profile will show that the line for any one gradient advances in a very flat curve except at starting. For all practical purposes the line can be assumed as advancing in a straight line throughout the length of a single stretch of gradient or to the point

TABLE NO. 2

WEIGHT CARS AND LADING 1306 TONS
WEIGHT LOCOMOTIVE 173 "
TOTAL TRAIN 1479 "

ACCELERATIONS AND RETARDATIONS

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HANDLE ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED.

ENGINE WORKING STEAM - ASCENDING GRADES.

VELOCITY MILES PER HOUR	0.0 GRADE	+0.1 GRADE	+0.2 GRADE	+0.3 GRADE	+0.4 GRADE	+0.5 GRADE	+0.6 GRADE	+0.7 GRADE	+0.8 GRADE	+0.9 GRADE	+1.0 GRADE
0	.04	.05	.06	.07	.08	.11	.16	.29	WILL NOT START	WILL NOT START	
1	.15	.18	.20	.23	.28	.35	.47	.73	.74	2.56	
2	.33	.39	.43	.50	.60	.71	.92	1.33	1.66	4.48	WILL NOT START
3	.59	.67	.75	.87	1.03	1.19	1.52	2.12	2.82	6.70	23.33
4	.92	1.02	1.16	1.34	1.58	1.81	2.29	3.14	4.33	9.61	62.70
5	1.33	1.48	1.68	1.94	2.29	2.68	3.41	4.72	7.00	59 16.48 / 78.32	62.93
6	1.87	2.09	2.39	2.78	3.32	4.01	5.29	7.94	69 16.18 / 104.81	71.08	56.05
7	2.56	2.89	3.33	3.93	4.78	6.06	8.66	17.32	85.35	63.30	53.18
8	3.43	3.91	4.56	5.48	6.89	9.29	15.74	83 37.46 / 95.04	73.42	59.65	51.03
9	4.50	5.18	6.13	7.53	9.87	14.67	99 38.86 / 157.48	89.33	68.29	56.90	49.15
10	5.79	6.74	8.11	10.31	14.17	25.02	126.52	80.64	64.52	54.49	47.38
11	7.33	8.64	10.60	13.91	20.69	58.91	101.18	74.94	61.31	52.26	45.67
12	9.16	10.95	13.74	18.80	31.77	161.06	90.66	70.38	58.40	50.12	43.98
13	11.33	13.76	17.74	25.75	57.84	119.39	83.43	66.42	55.67	48.04	42.30
14	13.89	17.19	22.93	36.35	144 71.75 / 4.23 37	104.62	77.67	62.84	53.07	46.00	40.62
15	16.93	21.42	29.86	55.55	151.71	94.88	72.70	59.50	50.56	43.99	38.94
16	20.54	26.67	39.49	113.30	126.62	87.32	68.24	56.34	48.11	41.99	37.25
17	24.84	33.29	53.90	171 119.38 / 239.29	112.18	80.90	64.11	53.30	45.70	40.00	35.55
18	29.96	41.77	78.45	170.16	101.53	75.20	60.22	50.35	43.31	38.01	33.84
19	36.11	52.96	139.80	142.75	92.74	69.96	56.49	47.45	40.94	36.01	32.11
20	43.56	68.47	20 220.29 / 326.81	125.25	85.07	65.05	52.88	44.59	38.58	34.00	30.36
21	52.65	91.45	221.50	111.90	78.15	60.43	49.36	41.76	36.22	31.97	28.58
22	63.82	129.86	177.86	100.71	71.73	55.93	45.90	38.94	33.85	29.92	26.78
23	77.82	222.54	151.08	90.80	65.65	51.54	42.47	36.12	31.46	27.84	24.95
24	95.59	24 3 378.60 / 486.21	131.14	81.79	59.83	47.24	39.06	33.29	29.05	25.74	23.09
25	118.62	307.27	114.57	73.36	54.18	42.99	35.65	30.45	26.61	23.61	21.19
26	149.54	227.94	100.00	65.34	48.65	38.76	32.23	27.58	24.14	21.44	19.26
27	194.05	181.56	86.75	57.61	43.19	34.54	28.79	24.68	21.63	19.23	17.29
28	264.05	147.64	74.47	50.11	37.79	30.32	25.33	21.75	19.08	16.98	15.28
29	401.75	119.74	62.84	42.76	32.42	26.08	21.84	18.78	16.49	14.69	13.23
30	30 751.64 / 786.63	95.45	51.68	35.50	27.05	21.82	18.31	15.77	13.86	12.36	11.14
31	457.43	73.61	40.88	28.33	21.68	17.53	14.74	12.71	11.18	9.98	9.00
32	236.93	53.56	30.38	21.22	16.30	13.21	11.13	9.61	8.46	7.56	6.82
33	131.12	34.84	20.11	14.14	10.90	8.85	7.47	6.46	5.69	5.09	4.59
34	57.84	17.07	10.00	7.07	5.47	4.45	3.76	3.26	2.87	2.57	2.32
35											

where speed becomes a maintained velocity, this method increasing slightly the total estimated time. The speed can be estimated from the tables to the nearest tenth of a mile per hour for the end of each stretch of gradient. For intermediate rates of grade not shown on the table, the values can be determined by interpolation. The speed diagram should be marked plainly showing points where drifting begins or ends. As a general proposition, where there is ample time for schedule of train between terminals, the locomotive should be considered as drifting on all the accelerating gradients where the distance in accelerating to the maximum safe velocity is not too great. In these tables 35 miles per hour has been taken as the average maximum safe speed for freight trains. The application of brakes at stops should be considered as time drifting, and frequently the arrangement of grades approaching stops is such that the locomotive can be considered as drifting and retarding with possibly a short final application of brakes. If at any portion of the line the locomotive would require less than its full power to keep the train at its maximum safe velocity or at a fixed rate of speed, for the purpose of estimating, the locomotive should be considered as working at full power for a distance and then drifting so as to produce as nearly the average rate as practicable. In calculating total time working or drifting the total area lying between the speed and base lines can be estimated for each, the mean velocity for each obtained and with distance known, the time for each calculated. A second method is to calculate the time for each stretch of grade to the nearest hundredth part of a minute, using the mean speed as a divisor. In this method a table of feet per minute for miles and tenths of miles per hour is a convenience particularly where slide rule is used.

Table No. 5 giving grades on which various weight trains can accelerate to and maintain the given velocities, is calculated using the same locomotive and train resistance per ton as for the other tables. The difference between the locomotive draw bar pull at given velocity and train resistance on level grade for the given train divided by the tons weight of train including locomotive gives the grade resistance for the gradient on which the given velocity can be maintained. The formula can be expressed as follows: P = draw bar pull level grade; R = resistance (train) level grade; T = tons train including locomotive; G = per cent gradient for maintained velocity at given speed. Then $G = \frac{P - R}{20\,T}$

The speed diagram platted, and both the time and distance calculated, divided between locomotive working and locomotive drifting, covers only the train for which the tables were calculated. The next step is to determine approximately what time would be required for other weight trains of the same average loading per car. With reference to trains drifting, the time and distance in accelerating or retarding between two given velocities is directly proportional to the

TABLE NO. 3

ACCELERATIONS

WEIGHT CARS AND LADING 1306 TONS
WEIGHT LOCOMOTIVE 173 "
TOTAL TRAIN 1479 "

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HANDLE ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED.

LOCOMOTIVE WORKING STEAM - DESCENDING GRADES.

VELOCITY MILES PER HOUR	0.0 GRADE	-0.1 GRADE	-0.2 GRADE	-0.3 GRADE	-0.4 GRADE	-0.5 GRADE	-0.6 GRADE	-0.7 GRADE	-0.8 GRADE	-0.9 GRADE	-1.0 GRADE
0	.04	.04	.03	.03	.03	.03	.02	.02	.02	.02	.02
1	.15	.14	.12	.12	.11	.10	.09	.08	.08	.08	.07
2	.33	.31	.28	.26	.24	.22	.20	.19	.18	.17	.16
3	.59	.54	.49	.45	.42	.39	.36	.34	.32	.30	.28
4	.92	.83	.76	.70	.65	.60	.56	.53	.50	.47	.45
5	1.33	1.20	1.10	1.01	.94	.87	.81	.76	.72	.68	.65
6	1.87	1.68	1.54	1.41	1.31	1.21	1.13	1.06	1.00	.94	.90
7	2.56	2.29	2.09	1.90	1.76	1.63	1.52	1.42	1.34	1.26	1.20
8	3.43	3.05	2.76	2.50	2.31	2.13	1.98	1.85	1.74	1.63	1.55
9	4.50	3.97	3.57	3.22	2.96	2.72	2.52	2.35	2.21	2.07	1.96
10	5.79	5.07	4.52	4.06	3.72	3.41	3.15	2.93	2.75	2.57	2.43
11	7.33	6.36	5.63	5.04	4.59	4.20	3.87	3.59	3.36	3.13	2.96
12	9.16	7.87	6.92	6.16	5.59	5.09	4.68	4.33	4.04	3.76	3.55
13	11.33	9.63	8.41	7.44	6.73	6.10	5.59	5.16	4.80	4.46	4.21
14	13.89	11.68	10.11	8.90	8.01	7.23	6.61	6.09	5.65	5.24	4.94
15	16.93	14.06	12.06	10.55	9.44	8.50	7.75	7.12	6.59	6.10	5.74
16	20.54	16.81	14.28	12.41	11.04	9.91	9.01	8.25	7.62	7.05	6.62
17	24.84	19.99	16.81	14.50	12.82	11.47	10.40	9.49	8.75	8.08	7.57
18	29.96	23.66	19.67	16.84	14.80	13.19	11.92	10.85	9.98	9.20	8.60
19	36.11	27.90	22.90	19.45	16.99	15.08	13.58	12.33	11.32	10.41	9.71
20	43.56	32.81	26.56	22.36	19.41	17.15	15.39	13.94	12.77	11.72	10.91
21	52.65	38.48	30.68	25.59	22.07	19.41	17.36	15.68	14.33	13.13	12.20
22	63.82	45.02	35.30	29.16	24.98	21.87	19.49	17.55	16.00	14.64	13.58
23	77.82	52.58	40.48	33.10	28.15	24.53	21.78	19.56	17.79	16.25	15.05
24	95.59	61.31	46.26	37.43	31.60	27.40	24.24	21.71	19.70	17.97	16.61
25	118.62	71.37	52.69	42.16	35.33	30.49	26.87	24.00	21.73	19.79	18.26
26	149.54	82.96	59.82	47.31	39.36	33.80	29.68	26.44	23.89	21.72	20.01
27	194.05	96.40	67.73	52.91	43.70	37.34	32.67	29.03	26.17	23.76	21.85
28	264.05	111.93	76.46	58.98	48.36	41.12	35.84	31.77	28.58	25.91	23.79
29	401.75	129.89	86.06	65.53	53.34	45.13	39.20	34.66	31.11	28.17	25.82
30	30 751.64 786.65	150.77	96.62	72.59	58.65	49.38	42.75	37.70	33.77	30.54	27.95
31	457.43	175.27	108.23	80.19	64.30	53.88	46.49	40.89	36.56	33.02	30.17
32	236.93	204.25	120.98	88.36	70.31	58.63	50.42	44.24	39.48	35.61	32.49
33	131.12	238.74	134.94	97.11	76.68	63.64	54.54	47.75	42.53	38.31	34.91
34	57.84	280.02	150.18	106.45	83.42	68.91	58.86	51.42	45.71	41.12	37.43
35											

net accelerating or retarding forces per ton. The resistance per ton for the 1,479-ton train used in the tables is 6,427 pounds while drifting and the "grade of repose" on which velocity would neither increase or decrease is practically 0.32%. Considering two other trains with the same locomotive and train resistance (5.4 lbs.) per ton, one 873 tons gross, including locomotive and the other 3,173 tons gross, the following gives a comparison of the time and distance in accelerating on descending 1.0% and 0.4% gradients:

Gross Wt. Train, tons.....	1,479	873	3,173
Resist. per ton drifting, lbs.....	6.427	7.140	5.880
Grade of repose, per cent.....	0.321	0.357	0.294
Accelerating force 1.0%, lbs.....	13.573	12.860	14.120
Accelerating force, 0.4%, lbs.....	1.573	0.860	2.120
Distance 5 to 35 M.P.H.....			
On 1.0%, feet.....	6,183	6,539	5,949
On 0.4%, feet.....	53,415	97,674	39,623
Time 5 to 35 M.P.H.....			
On 1.0%, minutes.....	4.010	4.240	3.860
On 0.4%, minutes.....	34.670	63.390	25.720

The above shows that the lighter train takes a greater distance and more time to accelerate between two given speeds and in the case of the 0.4% grade the difference is very marked, and that in accelerating the same distance as the 1,479-ton train the final velocity would be less for the 873-ton train and would be reached earlier by the 3,173-ton train. All trains of a district will have the same distance and grades to pass over. The following shows the time drifting the same distance with an initial velocity of 5 M.P.H. for widely different trains on heavy and light gradients:

Grade.....	1.0%			0.4%		
Distance.....	3183.00			53,415.		
Gross tons train..	1479.00	873.00	3173.00	1479.00	873.00	3173.00
Time, minutes...	4.01	4.10	3.94	34.67	46.51	30.20
Final Vel., M.P.H.	35.00	34.25	35.00	35.00	26.10	35.00

The above is from a theoretical standpoint and in practical operation the trains on the flatter grade would be accelerated by locomotive working to some velocity approaching the safe maximum rather than waste time drifting ten miles or more to reach that velocity. The difference in time drifting is very rapidly dispelled as grade increases above 0.4%; therefore for all practical purposes trains of different weights and average loading per car can be assumed as drifting the same distance and in the same time.

The time working locomotive will vary widely and the method of approximating this time for various weight of trains of average car loading can be best explained by taking an example for illustration. Consider a speed diagram for the tabular train platted over the following distance with the given results:

Length of district.....	120 miles
Controlling gradient	0.6%
Maximum tons cars and loading at 5 M.P.H. velocity on controlling grade (average car loading)	1,986 tons
Time drifting with diagram train.....	2 hours

TABLE NO. 4

ACCELERATIONS AND RETARDATIONS

WEIGHT CARS AND LADING 1306 TONS
WEIGHT LOCOMOTIVE 173 "
TOTAL TRAIN 1479 "

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HANDLE ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED

	LOCOMOTIVE DRIFTING AND ACCELERATING							LOCOMOTIVE DRIFTING AND RETARDING						
VELOCITY MILES PER HOUR	-1.0 GRADE	-0.9 GRADE	-0.8 GRADE	-0.7 GRADE	-0.6 GRADE	-0.5 GRADE	-0.4 GRADE	-0.3 GRADE	-0.2 GRADE	-0.1 GRADE	0.0 GRADE	+0.1 GRADE	+0.2 GRADE	+0.3 GRADE
0														
1	.09	.12	.18	.36				2009.00	353.42	193.55	133.56	101.71	82.11	69.26
2	.28	.35	.48	.78	.71	2.16		2007.36	353.13	193.39	133.45	101.63	82.04	69.20
3	.56	.68	.89	1.32	1.49	3.58	7.45	2002.44	352.26	192.92	133.12	101.38	81.84	69.03
4	.92	1.10	1.40	1.97	2.38	4.99	10.78	1994.24	350.82	192.13	132.57	100.96	81.50	68.75
5	1.38	1.64	2.06	2.80	3.51	6.75	14.79	1982.76	348.80	191.02	131.81	100.38	81.03	68.35
6	1.95	2.31	2.86	3.82	4.89	8.91	19.69	1968.00	346.20	189.60	130.83	99.63	80.43	67.84
7	2.62	3.10	3.81	5.02	6.52	11.46	25.48	1949.96	343.03	187.86	129.63	98.72	79.69	67.22
8	3.39	4.01	4.91	6.41	8.40	14.40	32.16	1928.64	339.28	185.81	128.21	97.64	78.82	66.49
9	4.27	5.04	6.15	7.98	10.53	17.73	39.73	1904.04	334.25	183.44	126.57	96.39	77.81	65.64
10	5.25	6.19	5.54	9.74	12.92	21.45	48.19	1876.16	330.05	180.75	124.72	94.98	76.67	64.68
11	6.33	7.46	7.07	11.68	15.56	25.57	57.54	1845.00	324.57	177.75	122.65	93.40	75.40	63.61
12	7.52	8.85	8.75	13.81	18.45	30.08	67.78	1810.56	318.51	174.43	120.36	91.64	73.99	62.42
13	8.81	10.36	10.58	16.12	21.59	34.98	78.91	1772.84	311.87	170.80	117.85	89.75	72.45	61.12
14	10.20	11.99	12.55	18.62	24.98	40.27	90.93	1731.84	304.66	166.85	115.12	87.67	70.77	59.71
15	11.69	13.74	14.67	21.30	28.62	45.95	103.84	1687.56	296.87	162.58	112.18	85.43	68.96	58.18
16	13.29	15.62	16.93	24.17	32.51	52.03	117.64	1640.00	288.50	158.00	109.02	83.02	67.02	56.54
17	14.99	17.62	19.34	27.22	36.65	58.50	132.33	1589.16	279.56	153.10	105.64	80.45	64.94	54.79
18	16.79	19.74	21.90	30.46	41.04	65.36	147.91	1535.04	270.04	147.89	102.04	77.71	62.73	52.93
19	18.70	21.98	24.60	33.88	45.65	72.61	164.38	1477.64	259.94	142.36	98.22	74.80	60.38	50.95
20	20.71	24.34	27.45	37.49	50.58	80.25	181.74	1416.96	249.27	136.51	94.19	71.73	57.90	48.86
21	22.82	26.82	30.44	41.28	55.73	88.29	199.99	1353.00	238.02	130.35	89.94	68.49	55.29	46.66
22	25.04	29.42	33.58	45.26	61.13	96.72	219.13	1285.76	226.19	123.87	85.47	65.09	52.54	44.34
23	27.36	32.14	36.87	49.42	66.78	105.54	239.16	1215.24	213.78	117.08	80.78	61.52	49.66	41.91
24	29.78	34.98	40.30	53.77	72.68	114.75	260.08	1141.44	200.80	109.97	75.87	57.78	46.64	39.37
25	32.30	37.94	43.88	58.30	78.83	124.35	281.89	1064.36	187.24	102.54	70.75	53.88	43.49	36.71
26	34.93	41.03	47.60	63.02	85.23	134.35	304.59	984.00	173.10	94.80	65.41	49.81	40.21	33.92
27	37.66	44.24	51.47	67.92	91.88	144.74	328.18	910.36	158.39	86.74	59.85	45.58	36.79	31.04
28	40.49	47.57	55.49	73.01	98.78	155.52	352.66	813.44	143.10	78.37	54.07	41.18	33.24	28.05
29	43.43	51.02	59.65	78.28	105.93	166.69	378.03	723.24	127.23	69.68	48.07	36.61	29.55	24.94
30	46.47	54.59	63.96	83.74	113.34	178.25	404.29	629.76	110.79	60.67	41.86	31.88	25.73	21.72
31	49.61	58.28	68.41	89.38	121.00	190.21	431.44	533.00	93.77	51.35	35.43	26.98	21.78	18.39
32	52.86	62.09	73.01	95.21	128.91	202.56	459.48	432.96	76.17	41.71	28.78	21.92	17.69	14.94
33	56.21	66.02	77.76	101.22	137.07	215.30	488.41	329.64	57.99	31.76	21.91	16.68	13.47	11.38
34	59.66	70.07	82.65	107.42	145.48	228.43	518.23	223.04	39.24	21.49	14.82	11.29	9.11	7.71
35	63.21	74.24	87.69	113.80	154.14	241.95	548.94	113.16	19.91	10.90	7.52	5.73	4.62	3.92

Time working with diagram train..... 5 hours
Distance working ..... 90 miles

The average velocity of the train while locomotive is working is 18 miles per hour. From table 5 we find the 1,306-ton train back of locomotive can maintain a velocity of 18 miles per hour on 0.27 gradient. A table can now be prepared for the district from table five showing the velocities and time for trains of other weight moving in the same direction. The 0.27% gradient is the approximate average gradient considered for all the trains, and with the velocities for the different trains on this gradient taken from table 5, the time locomotive is working can be calculated for each. An example of such a table is presented, including a train in excess of the maximum that can be hauled over the controlling grades.

1900	12.33	7.30	2.0	9.30	33,060	5.45
2100	10.67	8.44	2.0	10.44	36,540	....

From this table the running time for the maximum train with draw-bar pull of 34,556 can be interpolated and will be found to be 9.79 hours total. The running time for any train with the average car loading or the tons of train for any desired schedule can be found by interpolation from the table. A very convenient form in which to put this is to plat it graphically with running time to scale on one side of chart and either the speed in M. P. H. on controlling grades, or draw-bar pull for given locomotive on the other. This is of particular value in making rating sheets for a given schedule over a district and with velocity in miles per hour on controlling grades is available for any locomotive that

TABLE NO. 5

GRADIENTS ON WHICH GIVEN VELOCITY CAN BE MAINTAINED FOR GIVEN TRAIN TONS

TRAIN RESISTANCE, 5.4 LBS. PER TON FOR VELOCITIES 4 MILES TO 35 MILES PER HOUR

LOCOMOTIVE C.T.P. AT 5 MILES PER HOUR, 39,000 WEIGHT OF LOCOMOTIVE, 173 TONS

VELOCITY MILES PER HOUR	700 TONS	800 TONS	900 TONS	1000 TONS	1100 TONS	1200 TONS	1306 TONS	1400 TONS	1500 TONS	1600 TONS	1700 TONS	1900 TONS	2100 TONS	2400 TONS	2700 TONS	3000 TONS	VELOCITY MILES PER HOUR
5	1.88	1.66	1.48	1.33	1.21	1.10	1.00	.92	.85	.78	.73	.64	.56	.46	.38	.32	5
6	1.69	1.49	1.33	1.19	1.08	.98	.89	.82	.75	.70	.64	.56	.48	.40	.33	.27	6
7	1.53	1.35	1.20	1.07	.97	.88	.79	.73	.67	.62	.57	.49	.42	.34	.28	.23	7
8	1.40	1.23	1.09	.97	.88	.79	.72	.66	.60	.55	.51	.43	.37	.30	.24	.19	8
9	1.29	1.13	1.00	.89	.80	.72	.65	.60	.55	.50	.46	.39	.33	.26	.20	.16	9
10	1.20	1.05	.93	.82	.74	.66	.60	.55	.50	.45	.41	.35	.29	.23	.175	.13	10
11	1.11	.97	.86	.76	.68	.61	.55	.50	.45	.41	.375	.31	.26	.20	.15	.11	11
12	1.03	.90	.79	.70	.63	.56	.50	.45	.41	.37	.34	.28	.23	.175	.125	.09	12
13	.96	.83	.73	.64	.58	.51	.46	.41	.37	.335	.305	.25	.20	.15	.10	.07	13
14	.89	.77	.67	.59	.53	.47	.42	.37	.33	.30	.27	.22	.175	.125	.08	.05	14
15	.82	.71	.62	.54	.48	.425	.38	.33	.30	.27	.24	.19	.15	.10	.06	.03	15
16	.76	.65	.57	.49	.44	.38	.34	.30	.27	.24	.21	.165	.125	.08	.04	.01	16
17	.70	.60	.52	.45	.40	.345	.30	.27	.24	.21	.18	.14	.10	.06	.02	.005	17
18	.64	.55	.47	.41	.36	.31	.27	.24	.21	.18	.155	.115	.08	.04	.005	.02	18
19	.59	.50	.43	.37	.32	.275	.24	.21	.18	.15	.13	.09	.06	.02	.01	.035	19
20	.54	.45	.39	.33	.28	.24	.21	.18	.15	.12	.105	.07	.04	.005	.025	.05	20
21	.49	.41	.35	.29	.25	.21	.18	.15	.12	.10	.085	.05	.02	.01	.04	.06	21
22	.45	.375	.31	.26	.22	.185	.15	.12	.10	.08	.065	.03	.005	.025	.05	.07	22
23	.41	.34	.28	.23	.19	.16	.13	.10	.08	.06	.045	.015	.01	.04	.06	.08	23
24	.37	.305	.25	.20	.16	.135	.11	.08	.06	.04	.025	.00	.025	.05	.07	.09	24
25	.33	.27	.22	.18	.14	.11	.09	.065	.045	.025	.01	.015	.04	.06	.08	.10	25
26	.30	.245	.19	.16	.12	.09	.07	.05	.03	.01	.005	.03	.05	.07	.09	.11	26
27	.27	.22	.17	.13	.10	.075	.05	.035	.015	.00	.02	.04	.06	.08	.10	.12	27
28	.24	.20	.15	.11	.085	.06	.035	.02	.00	.015	.03	.05	.07	.09	.11	.13	28
29	.22	.18	.13	.095	.07	.045	.02	.005	.015	.025	.04	.06	.08	.10	.12	.135	29
30	.20	.16	.11	.08	.055	.03	.005	.01	.025	.035	.05	.07	.09	.11	.13	.14	30
31	.18	.14	.095	.065	.04	.015	.005	.02	.035	.045	.06	.08	10	.12	.135	.145	31
32	.16	.12	.08	.05	.025	.00	.015	.03	.045	.055	.07	.09	.11	.125	.140	.15	32
33	.14	.10	.065	.035	.01	.01	.025	.04	.055	.065	.08	.10	.115	.13	.145	.155	33
34	.12	.085	.05	.02	.00	.02	.035	.05	.065	.075	.085	.105	.12	.135	.15	.16	34
35	.11	.07	.04	.01	.01	.03	.045	.06	.075	.085	.09	.11	.125	.14	.155	.165	35

ASCENDING GRADES SHOWN ABOVE HEAVY LINE DESCENDING GRADES SHOWN BELOW HEAVY LINE

Cars and Load, Tons	Vel. on 0.27%	Hours Working	Running Time Drifting	Total	On 0.6% D. B. Pull	Grade, Veloc.
700	27.0	3.33	2.0	5.33	12,180	18.81
800	25.0	3.60	2.0	5.60	13,920	17.00
900	23.33	3.86	2.0	5.86	15,660	15.38
1000	21.67	4.14	2.0	6.14	17,400	13.89
1100	20.33	4.43	2.0	6.43	19,140	12.51
1200	19.14	4.70	2.0	6.70	20,880	11.20
1306	18.0	5.00	2.0	7.00	22,724	9.92
1400	17.0	5.29	2.0	7.29	24,360	8.94
1500	16.0	5.63	2.0	7.63	26,100	8.04
1600	15.0	6.00	2.0	8.00	27,840	7.28
1700	14.0	6.43	2.0	8.43	29,580	6.61

makes steam for full cut-off at about the same velocity as the assumed locomotive. Assuming that the traffic each way per day is twelve trains divided equally between passenger, time freight and dead freight, spaced alternately, two hours apart at beginning of runs, with schedules over district of 4 hours for passenger, 10 hours for time freight and 12 hours for dead freight, the probable number of delay points for freights would be ten for time and eleven for dead freight.

The total schedule would be as follows:

	Time Freight	Dead Freight
Water, coal, orders, etc.....	1.00 hours	1.00 hours
Meeting and passing points.....	2.50 hours	2.75 hours
Drifting	2.00 hours	2.00 hours

Working	4.50 hours	6.25 hours
Total schedule	10.00 hours	12.00 hours
Weight cars and contents (average loading)	1,126 tons	1,658 tons
D. B. pull maximum grade	19,592 lbs.	28,849 lbs.

The weight is interpolated from the table. With this data it is possible to estimate the fuel per engine mile or ton mile for the above trains, but to get the average used it is necessary to work up the data for trains in both directions. The time being calculated for the tabular train, the tables can be used in many ways for approximations.

Take the 1,658-ton train just used in the preceding example. It is desired to know the approximate tons of train of light loading of cars that can be handled over the district in the same time. The mean draw bar pull of the 1,658-ton freight on the average 0.27 per cent grade would be 17,906 lbs. If the lighter loading is such as to produce a draw bar pull of 8 lbs. per ton on the level, on the average grade of 0.27 per cent it would be 13.41 lbs. and 1,336 tons would be the approximate weight of the lighter loaded train that could be handled in the same time with a draw bar pull of 23,246 lbs. on the controlling grade. This train would make faster time on grades in excess of the average and slower time on the lighter grades, the draw bar pull being less than for the 1,658-ton train for the heavier gradient, and greater as the grade decreases below the average.

Taking the same resistance of 8 lbs. per ton for level grades, it is desired to find the additional time it will take to handle a train with the same draw bar pull on the controlling grade as the 1,658-ton train. The draw bar pull on 0.6 per cent grade is 28,849 lbs. and the train of lighter car loading would weigh approximately 1,442 ton cars and contents, or 1,615 tons gross. Take the formula $G = \frac{P-R}{20T}$; then $P = 20\ TG + R$. Substituting the values, tons of train $T = 1{,}615$; grade $G = 0.27$; train resistance on level $R = 11{,}536$, the draw bar pull on the level, $P = 20{,}257$. Table No. 1 shows this locomotive draw bar pull at 13.26 M. P. Hour. To cover the 90 miles working would require 6.78 hours or 32 minutes longer than the 1,658-ton train, and in this particular case would probably require the payment of one hour over time to the engine and train crews according to the usual pay schedule providing that all time in excess of 10 miles per hour over a district be paid for with overtime calculated for each trip to the nearest even hour.

The use of the speed diagram will show the fallacy of considering rise and fall of the same amount, of equal value. The values for the same amount will vary with the gradients, speed of approach and location. As a general proposition, with the same character and loading of a train, and where runs of 15 miles or more can be made without stops, the time over two districts of the same rise and fall will be practically the same, but the fuel consumption on the district of lighter grade will be less.

The use of the speed diagram will solve the problems of fuel and water accounts and with schedules of pay of engine and trainmen at hand the main problems of "conducting Transportation" most affected by the physical characteristics of locations can be solved. A word of caution may be well at this point. Do not use the tables herewith unless they fit the local conditions as to fuel and resistance. Where these differ materially make up a set of tables on the same principles for best results. In platting speed line, make all necessary stops for fuel, water, railway crossings, etc., and a sufficient number of other points to cover meeting and passing of trains.

The method herein described requires work and time, but it does away with the more or less "scientific guesswork" with reference to the effect of distance, gradient, rise and fall, and curvature on the main accounts under conducting transportation expenses. There will be less disappointment in the expectation of producing a decreased train mileage directly in proportion to the decreased total resistance of train resistance on the controlling gradients. The actual economies realized will be much nearer the estimated economies than the average guess work. The most important value is that it will in many cases save the waste of money in the investment of so-called improvements which fail to realize a fair return on their cost.

The value of the method does not end with the engineer's estimate of relative economies of different routes, but with data for a district once worked out, many of the important problems of movement of traffic can be solved with sufficient accuracy to place the calculated results into practice, and with possibly a few slight changes found necessary in practice, render greater efficiency in operation. The value of additional main tracks can be estimated logically so that an executive official without technical education can understand the methods of reasoning even though he may not know the mathematical methods by which you determined the running time. The time spent in preparing the tables and in making the calculations for any given lines is in itself a foundation for greater economies, and the cost of this time will bring abundant results.

FIRE FIGHTING LOCOMOTIVES.

Steam railway locomotives as fire fighters have proved so efficacious on the Pennsylvania R. R. that that company has equipped 612 engines with special apparatus for use in case of fire. The special fire fighting apparatus consists of pumps and hose attached to switching engines regularly used in switching cars. The crews of these engines are systematically trained as fire fighters to put out promptly any fires that might occur in the hundreds of cars out of reach of city fire departments.

The yards are divided into districts, numbered as are fire alarm boxes in cities. When a fire is discovered, the nearest switch tower is notified and alarm whistles are blown throughout the yard limits. By a code of signals, engineers of locomotives within the yard can tell from the whistles just where the fire is. Each engine is uncoupled from its draft of cars as soon as the latter can be placed where they will not obstruct the main tracks. Yard masters and train directors give necessary orders to provide a clear track to the scene of the fire. Almost before the locomotives are uncoupled, signals are set indicating the routes by which to reach the fire, and by the time they arrive their crews have pumps unlimbered ready to work and hose ready to unreel. In the fire organization the assistant yard master acts as chief, and gives general directions both in fire fighting and in drills. The conductor of each train crew acts as foreman of that crew, the flagman looks after unreeling and connecting the hose, and the two brakemen act as nozzlemen, and direct the stream.

At a fire which occurred near the gas tank under a passenger car, the first engine was coupled up ready to act within two minutes after the alarm was sounded, while within seven minutes nine engines were on the scene. The locomotives equipped for fire fighting service are divided as follows on the Lines East of Pittsburgh and Erie; New Jersey Division, 216; Eastern Pennsylvania Division, 110; Western Pennsylvania Division, 131; Northern Division, 17; Erie Division and Northern Central Railway, 35; Philadelphia, Baltimore & Washington Railroad, 30, and Philadelphia Terminal Division, 73.

RECENT SANTA FE LOCOMOTIVES.

The Atchison, Topeka & Santa Fe Railway System has recently received 70 locomotives from the Baldwin Locomotive Works, as follows:

20 Santa Fe (2-10-2) type for oil burning.
10 Pacific (4-6-2) type for oil burning.
10 Pacific (4-6-2) type for coal burning.
10 Consolidation (2-8-0) type for oil burning.
14 Switching (0-6-0) type for oil burning.
6 Switching (0-6-0) type for coal burning.

In general, the new locomotives are duplicates of others already in service on the Santa Fe System. The differences between the former engines and the new ones are due to general development in locomotive design and to changes made necessary by minor weaknesses or by local conditions. While the new power represents the latest development in locomotive construction, the various details are interchangeable with corresponding parts of locomotives which have been in service on this railway system for years. In the development of its latest power the railway company has worked with the idea of keeping pace with most recent improvement, at the same time including in the designs those detail parts which are common to its former engines. In most instances where revision of design of individual parts has been necessary because of weakness, the new parts have been made interchangeable with the corresponding parts of older engines, thus reducing the number of patterns as well as the amount of repair part stock.

The boilers of all the new engines have radial stay fireboxes and all the locomotives for road service are equipped with Schmidt superheaters. A more detailed discussion of the principal features of the various classes follows:

Santa Fe Type Locomotives.

The first locomotives with this wheel arrangement were placed in service by the Santa Fe System in 1903, and during the years 1903-1907, a total of 160 locomotives of this type were built by the Baldwin Locomotive Works for service on the mountain divisions of the Santa Fe. Some of these engines have undergone extensive alterations by the railway company since they were first constructed, and several have been converted into Mallet compounds by the addition of forward units. The new locomotives are of the same general design as those previously built. The most notable change lies in the use of superheated steam in single expansion cylinders, instead of saturated steam in tandem compound cylinders and a slight increase in weight due chiefly to the use of a larger boiler. The shell diameter at the front end, has been increased from 78¾ inch to 80¾ inch, and the tubes have been lengthened from 20 feet 0 inch to 21 feet 0 inch. The firebox dimensions, however, are practically unchanged.

The superheater is of the Schmidt type, with 36 elements, which are placed in as many 5½ inch flues. The steam piping is arranged in accordance with recent practice, and superheated steam is delivered direct to the steam chests through outside pipes. Inside admission piston valves, 16 inches in diameter, control the steam distribution. These valves are driven by Walschaerts gear and are set with a lead of ¼ inch. The Ragonnet power reverse mechanism has been applied as a result of continued trial on previous engines of other classes. The main cylinders are oiled by a five-feed lubricator which has a lead to each steam pipe and one to each cylinder barrel.

The frames are of .40 per cent carbon steel, with main sections 5 inches wide cast in one piece with single front rails. Transverse braces of cast steel are placed midway between the adjacent pairs of driving pedestals, except at the rear where the brace is placed close to the fifth driving axle. This brace forms a seat for the sliding shoes which support the front end of the firebox. Just back of the fifth pair of pedestals, the rear frames are spliced to the main frames. The rear truck is of the Rushton type with inside journals as applied to the previous engines of the same general design. The back end of the firebox is supported on an expansion plate which is bolted to the foot plate.

Santa Fe Type Locomotive Recently Built for the A., T. & S. F.

Due provision has been made for bracing the frames at the front end. Just forward of the cylinders, they are secured to a cast steel deck-plate; while between the cylinders and the leading driving pedestals is a most substantial transverse brace of cast steel, which supports the driving brake shaft. The brake cylinders are bolted to the guide yoke. Each guide bearer is braced by a longitudinal cast steel tie, which is bolted at its forward end to the top of the steam chest.

As in the ten-coupled locomotives of the Santa Fe type recently built for the Chicago, Burlington & Quincy, counterweights are keyed to the main axle between the frames, to compensate for deficiency of weight in the wheel centers.

The equipment of these locomotives includes cylinder relief valves, also drifting valves of the Sheedy pattern. Flange lubricators are applied to the leading pair of driving wheels. The oil-burning equipment is in accordance with the railway company's practice. A two-inch Booth burner is used and it is placed in the forward end of the firebox.

Pacific Type Locomotives.

These locomotives are generally similar to the 28 balanced compound Pacific type engines built for this road last year, by the Baldwin Locomotive Works. The tractive force exerted, working compound, is 34,000 pounds.

The inside (high pressure) cylinders are placed on an angle of 7½ degrees, with their centers 26¾ inches above the outside cylinder centers, measured on the vertical center line of the cylinder casting. The high pressure piston rods are somewhat shorter than the low pressure, in order to allow sufficient clearance between the main rods and the first driving axle. When the inside cranks are on the back dead center, the crossheads are immediately above this axle. The inside guides are of the Laird type, this design having been adopted because it provides a maximum amount of clearance under the crossheads. These guides are supported, in front, by the yoke which braces the outside guides and independent of the back cylinder heads. At the back they are bolted to a substantial steel casting which extends the full depth of the leading driving pedestals. This casting has formed in it two openings, through which pass the high pressure main rods. Immediately in the rear of this casting, the upper frame rails are braced by the valve motion bearer. Another brace, a short distance ahead of the rear driving pedestals, is bolted to both the upper and lower frame rails. The transverse bracing of the frames in a four cylinder balanced engine presents some difficult problems, but in the locomotives under discussion a most satisfactory arrangement has been worked out.

The design of the superheater calls for no special comment. The steam pipes pass out through the sides of the smoke-box and deliver steam directly to the steam chests. The construction of the cylinder castings is thus materially simplified, the more so as the valves are arranged for inside admission to the high pressure cylinders. Walschaerts motion is used, and as the gears are driven from the outside (low pressure) pins, they are arranged in the same manner as when using outside admission valves on a single expansion locomotive. The gears are controlled by the Ragonnet power mechanism.

The coal burning locomotives are equipped with brick arches, and the grates and fire-door are operated by pneumatic power. The ash pan has three hoppers, with swing bottoms which can be operated independently of each other. Special attention has been given to equipping the locomotives so that they can be conveniently handled.

Consolidation Type Locomotives.

These locomotives exert a tractive force of 48,800 pounds, and carry an average weight of nearly 49,000 pounds on each pair of driving wheels. The general design is based on that of consolidation engines which were placed in service in 1908. The weight has been somewhat increased, due to enlarging the boiler to accommodate the superheater.

A wagon-top boiler with wide firebox is used in this design, and the front portion of the mud ring is sloped to secure sufficient depth at the throat. The staybolts are so spaced that a brick arch with water tubes can be applied, if at any time it is desired to change the locomotives to coal burners.

As in the other road engines, the superheater is arranged with outside steam pipes, and the valves are driven by Walschaerts motion. In the present instance, the link and reverse shaft bearings are bolted to the guide bearer. The combining levers are pinned directly to the valve stems. A longitudinal bearer is placed on each side of the locomotive, and is supported in front on the cylinder casting and at the back on the guide yoke. To this bearer is bolted a bracket which supports the valve rod. This arrangement provides an efficient brace for the guide yoke, in addition to a valve rod support which is independent of the main guides.

The frames are 4½ inches wide, with double front rails. A transverse brace, extending the full depth of the pedestals, is placed midway between the second and third, and third and fourth axles respectively. The firebox is supported by sliding shoes in front and an expansion plate at the back.

Switching Locomotives.

These engines are all equipped with Stephenson link motion, the steam distribution being controlled by 12-inch piston valves. They have wagon-top boilers with long fireboxes placed above the frames. The cylinders are 20 in. x 26 in., and with 51 in. wheels and a steam pressure of 180 pounds, the tractive force is 31,200 lbs. The total weight, equipped for coal burning, is 154,000 pounds. The design is one which the Santa Fe has used in general switching service with very satisfactory results.

The reversion in this order, to the 2-10-2 type locomotive for heavy freight service is a matter of considerable interest, indicating, as it does, the success achieved by the former engines of this type. The retention of the balanced compound in heavy duty passenger service is also noteworthy. These locomotives are among the most highly developed thus far built, and their successful performance can safely be assured.

Santa Fe Type Freight Locomotives.

Gauge	4 ft. 8½ in.
Cylinders	28 in. x 32 in.
Valves	Balanced piston
Boiler.	
Type	Wagon top
Material	Steel
Diameter	80¾ in.
Thickness of sheets	25/32 in., 27/32 in., ⅞ in.
Working pressure	170 lbs.
Fuel	Oil
Staying	Radial
Firebox.	
Material	Steel
Length	108 in.
Width	78 in.
Depth, front	80½ in.
Depth, back	77½ in.
Thickness of sheets, sides	⅜ in.
Thickness of sheets, back	⅜ in.
Thickness of sheets, crown	⅜ in.
Thickness of sheets, tube	9/16 in.
Water Space.	
Front	6 in.
Sides	6 in.
Back	6 in.
Tubes.	
Diameter	5½ in. x 2¼ in.
Material	Iron
Thickness	5½ in., No. 9 W. G.
Thickness	2¼ in., No. 11 W. G.
Number	5½ in., 36; 2¼ in. 251
Length	21 ft. 0 in.
Heating Surface.	
Firebox	193 sq. ft.
Tubes	4,174 sq. ft.
Total	4,367 sq. ft.
Grate area	58.5 sq. ft.
Driving Wheels.	
Diameter, outside	57 in.
Diameter, center	50 in.
Journals, main	11 in. x 12 in.
Journals, others	10 in. x 12 in.
Engine Truck Wheels.	
Diameter, front	29¼ in.
Journals	6½ in. x 10½ in.
Diameter, back	40 in.
Journals	7½ in. x 12 in.
Wheel Base.	
Driving	19 ft. 9 in.
Rigid	19 ft. 9 in.
Total engine	35 ft. 10 in.
Total engine and tender	66 ft. 4 in.
Weight.	
On driving wheels	248,900 lbs.
On truck, front	21,400 lbs.
On truck, back	25,600 lbs.
Total engine	295,900 lbs.
Total engine and tender, about	470,000 lbs.
Tender.	
Wheels, number	8

New Pacific Type Locomotive for the Santa Fe.

Wheels, diameter	34¼ in.
Journals	5½ in. x 10 in.
Tank capacity, water	9,000 gals.
Tank capacity, oil	3,300 gals.
Service	Freight
Engine equipped with Schmidt superheater.	
Superheating surface, 910 sq. ft.	

Pacific Type Passenger Locomotives.

Gauge	4 ft. 8½ in.
Cylinders	17½ in. and 29 in. x 28 in.
Valves	Balanced piston

Boiler.

Type	Wagon top
Material	Steel
Diameter	70 in.
Thickness of sheets	23/32 in., 13/16 in., ⅞ in.
Working pressure	210 lbs.
Fuel	Soft coal
Staying	Radial

Firebox.

Material	Steel
Length	109⅝ in.
Width	76¼ in.
Depth, front	75½ in.
Depth, back	65¼ in.
Thickness of sheets, sides	⅜ in.
Thickness of sheets, back	⅜ in.
Thickness of sheets, crown	⅜ in.
Thickness of sheets, tube	9/16 in.

Water Space.

Front	5 in.
Sides	5 in.
Back	4½ in.

Tubes.

Diameter	5½ in. and 2¼ in.
Material	Iron
Thickness	5½ in., No. 9 W. G.
Thickness	2¼ in., No. 11 W. G.
Number	5½ in., 26; 2¼ in., 199
Length	21 ft. 0 in.

Heating Surface.

Firebox	181 sq. ft.
Tubes	3,233 sq. ft.
Firebox tubes	29 sq. ft.
Total	3,443 sq. ft.
Grate area	57.6 sq. ft.

Driving Wheels.

Diameter, outside	73 in.
Diameter, center	66 in.
Journal, main	11 in. x 10 in.
Journal, others	9 in. x 12 in.

Engine Truck Wheels.

Diameter, front	34¼ in.
Journals	6 in. x 10 in.
Diameter, back	50 in.
Journals	8 in. x 14 in.

Wheel Base.

Driving	13 ft. 8 in.
Rigid	13 ft. 8 in.
Total engine	35 ft. 1 in.
Total engine and tender	66 ft. 11¾ in.

Weight.

On driving wheels	163,500 lbs.
On truck, front	54,600 lbs.
On truck, back	50,700 lbs.
Total engine	268,800 lbs.

New Consolidation Locomotive for the Santa Fe.

Total engine and tender, about.....440,000 lbs.

Tender.

Wheels, number 8
Wheels, diameter .....34¼ in.
Journals.....5½ in. x 10 in.
Tank capacity.....9,000 gals.
Fuel capacity.....12 tons
Service ..... Passenger
Engine equipped with Schmidt superheater.
Superheating surface, 619 sq. ft.

Consolidation Locomotives.

Gauge.....4 ft. 8½ in.
Cylinders.....23½ in. x 32 in.
Valves .....Balanced Piston

Boiler.

Type .....Wagon top
Material ..... Steel
Diameter .....78¾ in.
Thickness of sheets.....¾ in., 13/16 in., 27/32 in.
Working pressure.....185 lbs.
Fuel ..... Oil
Staying ..... Radial

Firebox.

Material ..... Steel
Length .....95½ in.
Width .....74¼ in.
Depth, front .....78½ in.
Depth, back .....68 in.
Thickness of sheets, sides.....⅜ in.
Thickness of sheets, back.....⅜ in.
Thickness of sheets, crown.....⅜ in.
Thickness of sheets, tube.....½ in.

Water Space.

Front .....4½ in.
Sides .....4 in.
Back .....4 in.

Tubes.

Diameter .....5⅜ in. and 2 in.
Material ..... Iron
Thickness.....5⅜ in., No. 9 W. G.
Thickness.....2 in., No. 11 W. G.
Number.....5⅜ in., 34; 2 in., 256
Length.....14 ft. 9 in.

Heating Surface.

Firebox ..... 200 sq. ft..
Tubes .....2,658 sq. ft.
Total .....2,858 sq. ft.
Grate area ..... 47.2 sq. ft.

Driving Wheels.

Diameter, outside .....57 in.
Diameter, center .....50 in.
Journals, main .....10 in. x 12 in.
Journals, others .....9 in. x 12 in.

Engine Truck Wheels.

Diameter .....29¼ in.
Journals.....6½ in. x 10½ in.

Wheel Base.

Driving .....15 ft. 6 in.
Rigid .....15 ft. 6 in.
Total engine .....24 ft. 6 in.

Weight.

On driving wheels.....195,500 lbs.
On truck ..... 30,800 lbs.
Total engine .....226,300 lbs.
Total engine and tender, about.....385,000 lbs.

Tender.

Wheels, number 8
Wheels, diameter .....34¼ in.
Journals.....5½ in. x 10 in.
Tank capacity, water.....8,500 gals.
Tank capacity, oil.....3,300 gals.
Service ..... Freight
Engine equipped with Schmidt superheater.
Superheating surface, 565 sq. ft.

LAUNDRY CARS.

The recent tour of the King-Emperor in India says the Locomotive Magazine, necessitated exceptional arrangements on the railways there to adequately compensate for the lack of first class European comforts in the more remote parts of that vast Empire.

To provide for the laundry requirements of their Imperial Majesties and suite a special laundry car 62 ft. long by 9 ft. 6 in. wide was included in the equipment of the auxiliary train accompanying the Imperial special. This car carried a boiler or "copper," wash tubs, mangle, etc., at the washing end, and ironing boards with heaters, etc., at the finishing end; the central portion of the car was used for drying and storing linen.

The car has a platform to open out at the side when in service at a depot or station.

Stewart D. Anderson, eastern representative of the Standard Railway Equipment Co., Pittsburgh, Pa., with office in New York, and formerly with the Hutchins Car Roofing Co., Detroit, Mich., died in Richmond, Va., on September 5.

E. Harrison Symington, western agent for the T. H. Symington Co., Baltimore, Md., with office in Chicago, died in Baltimore on September 5, after undergoing two operations for internal injuries.

Joseph T. Markham, for the past several years general sales agent of the Sellers Manufacturing Co., Chicago, has resigned from that position and on October 1st, will become vice president of the St. Louis Car Wheel Co., with headquarters in St. Louis.

The Western Electric Company, New York, will spend about $750,000 on enlarging its plant at Hawthorne, Ill., to take over the company's New York manufacturing business. The additions will be completed in about a year.

J. McA. Duncan has been appointed district manager of the Westinghouse Electric & Mfg. Co. for Pittsburgh district in place of Mr. W. F. Fowler, who has resigned to accept a position with the W. S. Kuhn Corporation. The Pittsburgh sales office has charge of all the sales for the Pittsburgh district and is one of the most important of the offices maintained by the electric company. Mr. Duncan has been in the employ of the Westinghouse Electric & Mfg. Co. for about 25 years, and is one of the original group of eight men taken from the Union Switch & Signal Company, then located on Garrison Alley, Pittsburgh, to form the electric company, which was established at the same place. His first position was in the shipping department where his ability was soon proved to the satisfaction of his employers, and he was placed in the correspondence department, of which he was afterwards placed in charge. In this position he had charge of all railway and lighting apparatus made by the rapidly growing company. In 1906 he was placed in charge of the price department, and, as head of this division of the company passed on prices of all apparatus manufactured. For a year or two he was located in the New York office on some special work in connection with the costs. Mr. Duncan then returned to East Pittsburgh and was attached to the manager of works' office as director of costs, and later as assistant manager of works in charge of production and costs. Last spring, when the present revival of industry began, the increased activity resulting from the additional business secured necessitated a division of work, and Mr. Duncan was appointed director of works accounting. He has assumed his new duties with the office in the Union Bank Building, Pittsburgh, Pa.

Mr. W. O. Jacquette has been appointed vice-president of the American Shop Equipment Co., Chicago, Ill., with office at 30 Church street, New York City. The company handles oil furnaces for welding, forging, melting and annealing, as well as many other shop devices.

The Central Vermont will make the following improvements: The elimination of five highway grade crossings in South Royalton, Vt.; the elimination of a highway grade crossing and bridge across the Winooski River; concrete construction in the towns of Colchester and South Burlington, Vt.

Watervliet Terminal, Delaware & Hudson Co.

By J. C. Chapple.

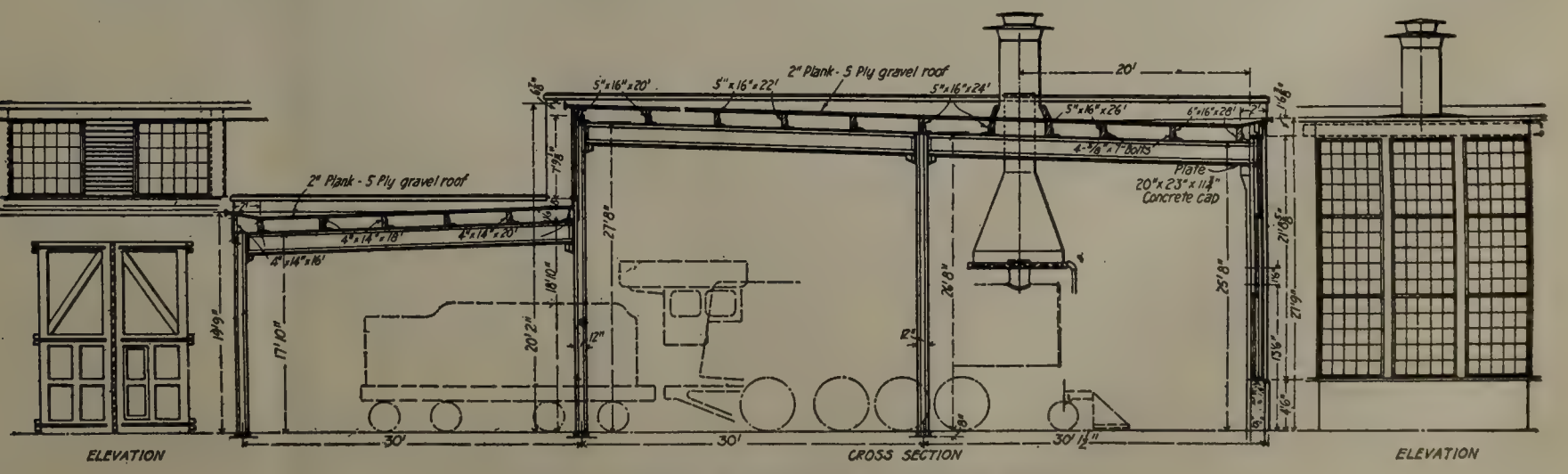
Having outgrown its coach yard facilities in the city of Albany, and its locomotive terminal and repair shop at Green Island, the Delaware & Hudson Company has combined the two at Watervliet, N. Y. (five miles north of Albany), and the result is a plant of such extensive proportions and modern equipment to equal any in the East.

Situated on a tract of land about 160 acres in area, the plant comprises a large locomotive terminal; a large coach yard in which passenger cars are cleaned and classified; a freight car receiving yard and repair shop; a paint shop; a general locomotive repair plant comprising main shop, foundry and hammer shop; and a general stores department. All the buildings are so situated that they can be extended in the future to suit the growth of the road without interfering with each other in the least.

As seen from the layout the longer dimension of the yard and also of the shop buildings lies in a general north and south direction; the incoming and outgoing tracks for the various departments also lie in this direction. A 100-foot span crane-runway 968 feet long, on which is mounted a 10-ton single trolley crane, extends over a general storage space between the main shop on one side and the store house and foundry on the other side. Just south of the general storage space and on a line with the freight car repair shop and planing mill is a 67½-foot runway 1,200 feet long provided with a 5-ton single trolley crane. By these two cranes and a system of industrial tracks all the departments are connected for exchange of material. A 5-ton single trolley crane mounted on an 85-foot runway 450 feet long serves the lumber storage yard south of the planing mill.

The locomotive terminal consists of a 30-stall roundhouse 379 feet in diameter with a 20-foot lean-to on the outer circle, extending over five stall spaces; and a rest house 38 by 52 feet. It is served by a 90-foot turntable and is provided with the necessary facilities for coaling, watering and storing, together with oil supply, water supply and ash pits. The building rests on a concrete foundation, which on the outside and end walls extends 4 feet 6 inches above the floor line, from which point windows 18 feet wide extend to the eaves, at which point steel lintels are used. Between the windows are 8½-foot brick pilasters, to the roof. The building is 90 feet between inner and outer walls. Two rows of steel columns spaced 30 feet on centers (and being the same distance from the outer wall), together with the steel door-posts in the inner wall, support the roof. The roof for the first 30 feet from the inner circle is 10 feet lower than the rest of the roof, allowing for a clerestory, which admits light and provides ventilation; this space over each stall being divided

Left to Right—Roundhouse, Power House, Truck Shop, Planing Mill and Car Shop.



Section Through Roundhouse, Watervliet Shops.

into a louver 4½ ft. by 6½ ft., and two windows 6½ ft. by 6½ ft. The inner circle is made up of hinged wooden doors without glass panels. The roof is a 5-ply gravel supported on wooden purlins. Asbestos smoke jacks are used, being spaced 20 ft. from the outer wall. A Nichols turntable tractor operates the turntable. A complete boiler washing system has been installed by the National Boiler Washing Co. of Chicago, the tanks and pumps being located in the power house. The lean-to or the roundhouse will be utilized for light running repairs and a tool room. The rest house contains a restaurant, sleeping room, rest room, wash and locker rooms for the convenience of trainmen. This building will also contain the offices of the roundhouse foreman, and engine dispatcher, together with the switchboard for the intercommunicating telephones for the entire shops. The round house together with the lean-to and rest house are heated by direct radiation.

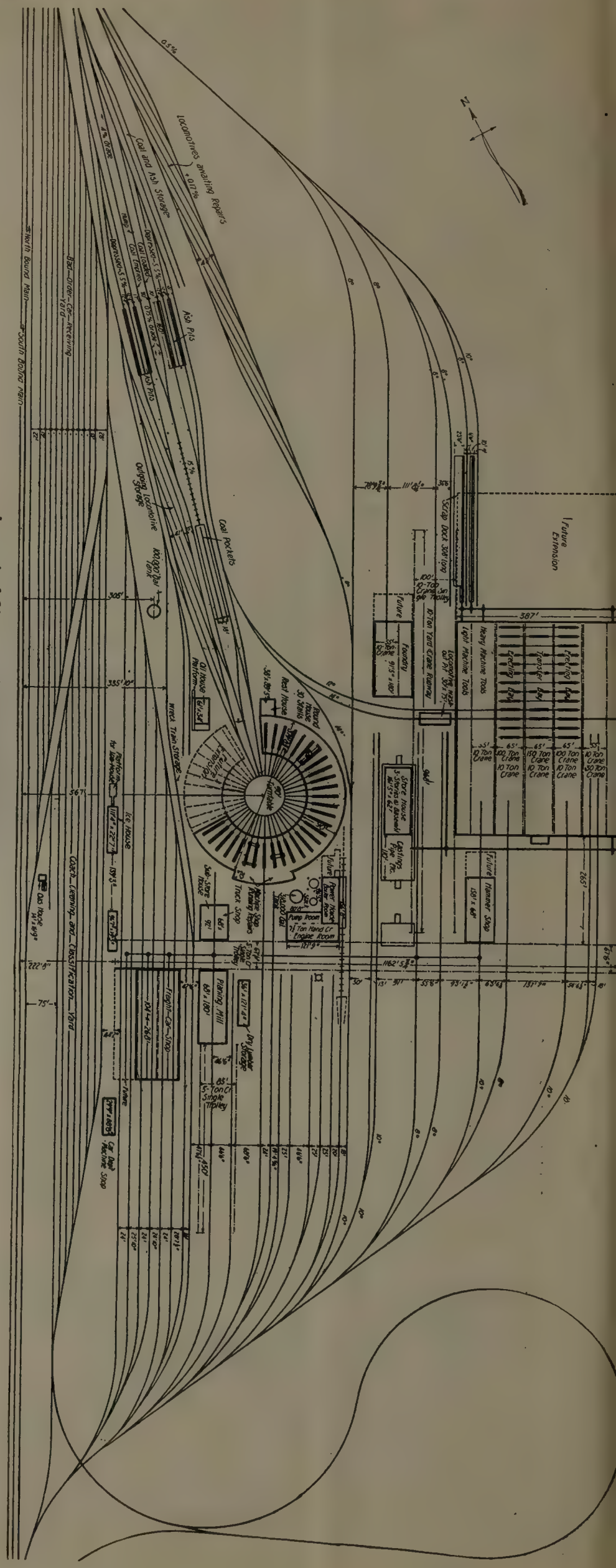
The incoming and outgoing tracks of the terminal are arranged to give the greatest possible advantage in handling locomotives to and from the roundhouse. There are four concrete ash pits each 160 feet long and arranged in pairs with a depressed ash track between the two pits of each pair. Between the two pairs of ash pits are the tracks for the coal pockets, one for the loaded cars and one for the empties. Cars are hauled up the incline to the pockets by means of an electric hoist. The pockets which have a capacity of 600 tons, are equipped with air operated automatic gravity measuring chutes of two and four ton capacity. The wet sand storage together with the sand drying and handling equipment is located at the end of the coal pockets, it being so arranged that locomotives can take sand and water simultaneously. A 100,000 gallon storage tank provides water for the locomotives. All of the incoming and outgoing tracks converge into three main tracks before entering the roundhouse. Between two of these tracks is a grill storage for outgoing locomotives each track accommodating two locomotives. This permits any engine to be handled without moving the others. There is also a storage for ash cars near the ash pits. The locomotive terminal is provided with an oil house 34 ft. by 60 ft. with basement. This oil house, having a capacity of over 45,000 gallons will also serve the entire plant, provisions having been made by large tanks to take care of the fuel oil which is pumped underground to the various departments. The pumps are the latest Gilbert & Barker model T-6 self measuring pumps and are equipped with gallon meters which record the total amount of oil drawn through each pump for a given period.

Coach Terminal.

The very heavy travel on the Delaware & Hudson lines caused by the many cities and places of interest and recreation being on said lines, calls for a large and fully equipped coach cleaning and classification yard. This is provided by a coach yard with over two miles of track. This yard is piped to all points, by means of underground pipe tunnels, with air, hot and cold water, steam, filtered drinking water, Pintsch gas, and a complete vacuum cleaning system, the equipment for same being located in the coach yard stores and office building which is 20 ft. by 96 ft. and located centrally with respect to the yard. An ice house 22 ft. by 111 ft. is located just north of the coach yard office and stores building, while directly across the yard isolated from all other structures is the gas plant. As a time saving device a complete loop has been formed in the south end of the plant, on which a complete train can be turned.

Freight Car Department.

This department consists of a freight car repair shop, a planing mill, a truck shop, repair tracks and a "bad order" storage yard. The freight car repair shop is 104 ft. by 268 ft. and is divided into two bays, each bay being served by a 15-ton crane. Two tracks together with an industrial track



Layout of Shops of the Delaware & Hudson Co., at Watervliet, N. Y.

Coaling Station and Trestle, Watervliet Shops.

enter each bay. For future extension of this building it is so constructed that another bay together with its accompanying crane and trucks can be added. There has also been provided for this department a small machine and blacksmith shop 22 ft. by 88 ft. in which light work will be done.

The planing mill is a building 68 ft. by 180 ft., having a track extending longitudinally its entire length. The lumber

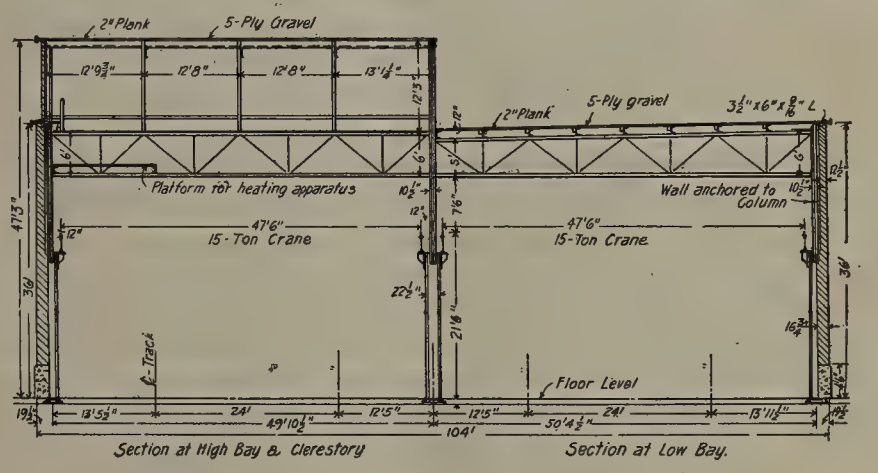
Interior of Freight Car Shop.

storage is located to the south of the planing mill and is served by a 5-ton crane. The dry lumber storage is located to the east of the planing mill. Just across the 67½ ft. crane runway and directly north of the planing mill is the truck shop. In connection with the truck shop is a sub-stores department. This relieves the general storeroom and also makes it more convenient for the freight car department to secure its material. All the buildings of this department are

tied together with a standard gauge industrial track. The freight car repair tracks, of which there are seven, extend both north and south from the freight car repair shop. In the north end of the plant is provided a "bad order" car receiving yard with a capacity of more than 300 cars.

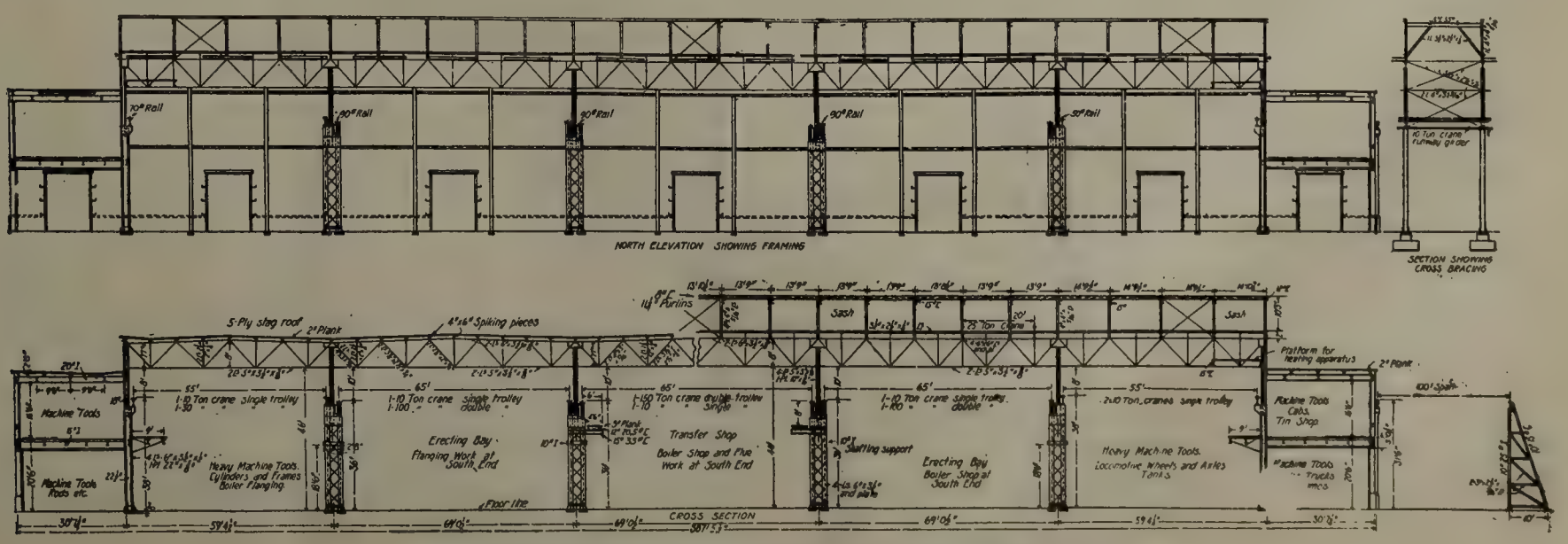
Locomotive Repair Shop.

With the exception of the hammer shop and foundry, all departments of the locomotive repair plant are under one roof in a building 510 ft. long by 387 ft. wide on the east



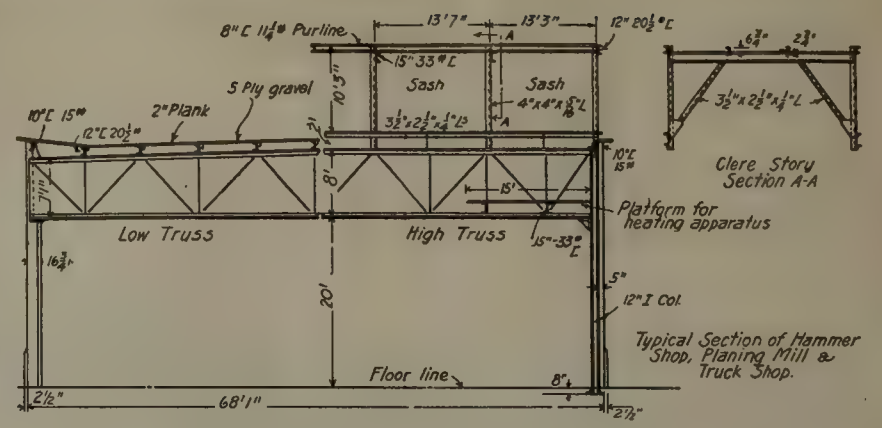
Section of Freight Car Shop at Watervliet.

side of the plant. This building consists of seven bays—the center bay and adjoining bays on each side of it are 69 ft. wide, the side bays 59 ft. in width, while the outside bays, which consist of a ground floor and gallery, are 30 ft. wide. The incoming track enters the west side about the middle of the building. On this track just outside of the entrance is a locomotive which may be covered with grease, dirt, etc., are given a thorough washing with hot water under pressure.


70# Rail
90# Rail
90# Rail
90# Rail
90# Rail
NORTH ELEVATION SHOWING FRAMING
10 Ton crane runway girder
SECTION SHOWING CROSS BRACING
5-Ply slag roof
2" Plank
4"x6" Spiking pieces
Sash
25 Ton Crane
Platform for hearing apparatus
2" Plank
Machine Tools
1-10 Ton crane single trolley
1-30 " "
1-10 Ton crane single trolley double
1-100 " "
Erecting Bay Flanging Work at South End
1-10 Ton crane double trolley single
1-10 " " "
Transfer Shop Boiler Shop and Fire Work at South End
1-10 Ton crane single trolley double
1-10 " " "
Erecting Bay Boiler Shop at South End
2-10 Ton cranes single trolley
Heavy Machine Tools. Locomotive Wheels and Axles Tanks
Machine Tools Cabs Tin Shop
Machine Tools Trucks
Heavy Machine Tools. Cylinders and Frames Boiler Flanging.
Machine Tools Rods etc.
Floor Line
CROSS SECTION

Section of Machine and Erecting Shop, Watervliet, N. Y.

Showing End of Planing Mill and Craneway.



Section of Hammer Shop at Watervliet.

By this means most of the grease and dirt can be removed much cheaper and in a more satisfactory manner than with the lye vats and it also makes the work of stripping much cleanlier.

The system of handling locomotives in this shop differs from the ordinary system in that a 150-ton overhead crane takes the place of the usual transfer table and pit, the space usually reserved for the table and pit being utilized for sorting material, etc. The engines are handled from the incoming track to the pit, upon which the stripping is to be done, by the 150-ton transfer crane. After being stripped the engines are placed on special trucks opposite the pit in either of the erecting bays in which the work is to be done. They are then dragged into the erecting bay by means of an electric drag which is moved from track to track as required by the cranes in the erecting bays. The erecting bays each have 13 pits. The transfer bay is provided with seven pits—one each on the incoming and outgoing tracks, the others on alternate tracks. The boilers requiring heavy repairs are carried directly to the boiler shop by the transfer crane. The various parts requiring repairs are distributed from the pit upon which the engine is stripped to the several departments assigned to the different work, while those not requiring repairs are stored in the transfer bay until needed for erecting. Each of the erecting bays is provided with a 100-ton 65 ft. span crane. In the south end under the east gallery is the small work smith shop, the remainder of the south end being utilized as a boiler and tank shop—each bay being served by a 10-ton crane. The north end and central portion of the two 59 ft. bays are used for heavy machine work, these bays being served by 10-ton and 30-ton cranes. In the bays containing the galleries the light machine work is done both on the ground floor and gallery. The ground floor department handles the rods, pistons, valves, etc., while the galleries accommodate the manufacturing tool room, brass room, electric repair room, paint shop, cab shop, tin shop, etc. The galleries are served by the cranes in the machine bays by means of platforms projecting 9 ft. from the galleries at suitable intervals.

Foundry.

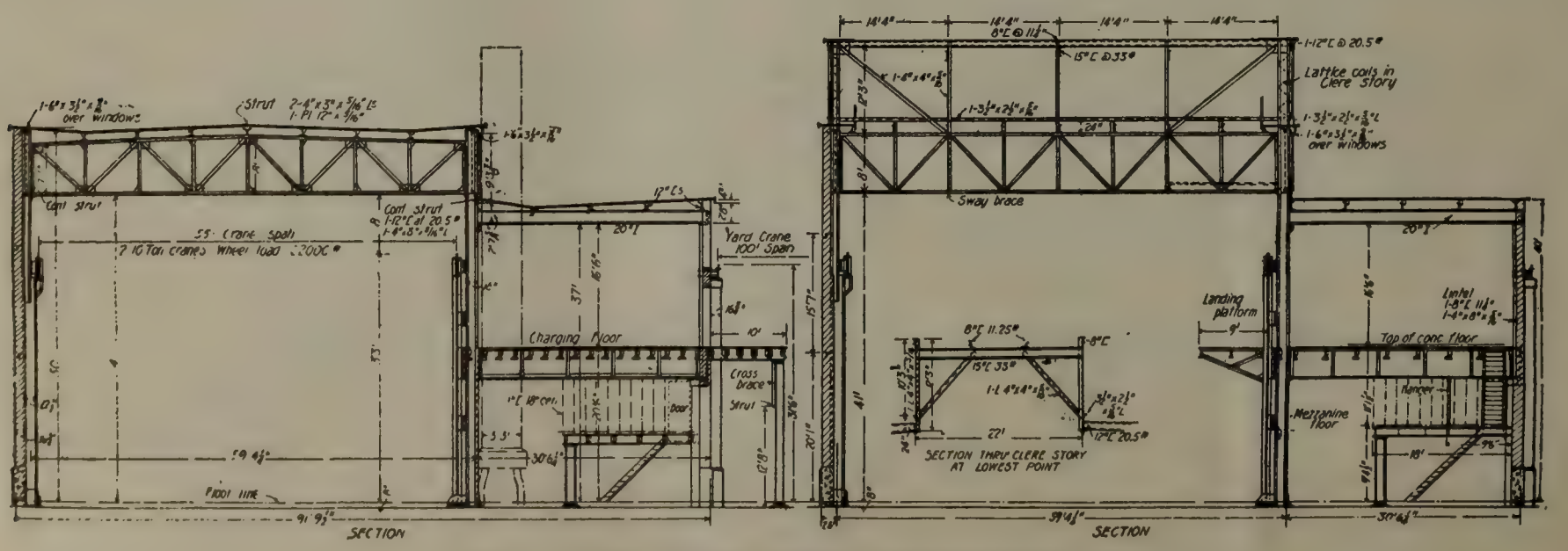
The foundry is 91 by 180 ft., and is located west of the main shop and separated from it by the 100 ft. span crane runway. The building consists of a main bay 60 ft. wide, served by a 10-ton crane which will be utilized for the cast iron and cast steel moulding floors, and a 30 ft. lean-to consisting of ground floor and gallery. In the gallery are the charging floors and brass foundry, while the ground floor beneath the gallery is utilized for the core ovens, tumblers, etc. The blowers together with the wash rooms, are located on a mezzanine floor between the gallery and ground floor. The gallery is served by an elevator from the ground floor, and also by both the foundry crane and the general storage crane by means of the overhanging platforms. The capacity of the iron foundry is 20-tons per day, and of the steel foundry 2-tons per hour. The cleaning room is provided with a dust exhaust system. This building is connected with the main shop by means of industrial tracks. Immediately north of the foundry is a two story building 53 ft. by 82 ft. which will be used for a pattern shop and pattern storage.

Hammer Shop.

The hammer shop is located south of the main shop and on a line with the 67½ ft. crane runway. This building is 68 ft. by 158 ft. and will be utilized for the heavy forging work. Extending through its entire length and into the main shop is a standard gauge track, which greatly facilitates the handling of the heavy material.

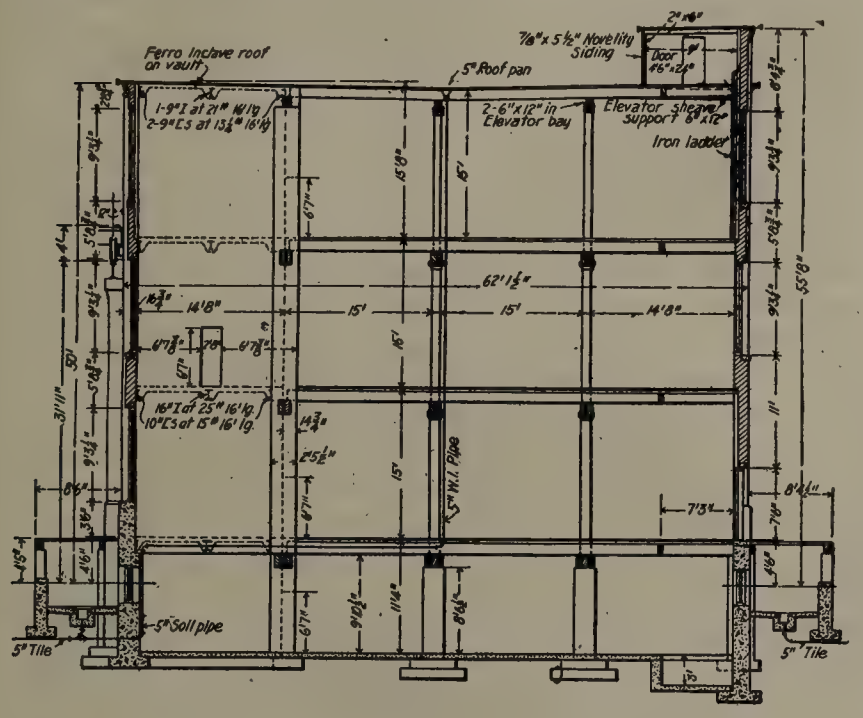
The Power Plant.

The power house is located on a line with the 67½ ft. crane runway just south of the roundhouse. It is an "L" shaped building 156 ft. by 121 ft. with boiler room 41 ft. wide and an engine and pump room 80 ft. wide. This plant is



Sections Through Foundry Building, Watervliet Shops.

practically auxiliary as the power is furnished from the Mechanicville power station of the Delaware & Hudson Co., 20 miles north of the shops. The power will be delivered at 11,000 volts, 40 cycles and transformed to 240 volts A. C., a motor generator set also being provided to convert this power into D. C., at 240 volts. The plant is also provided with a 350 K. W. D. C. reciprocating steam unit, the engine for same being furnished by the C. & G. Cooper Co., and the generator by the General Electric Co. The plant is also equipped with a generous compressed air-supply system consisting of a 2,000 ft. per minute steam air compressor, and a 2,000 ft. per minute motor driven air compressor, both of these machines being furnished by the Ingersoll-Rand Company. The steam power is generated by six 400 H. P. Babcock & Wilcox boilers in batteries of 800 H. P. each. The fuel will be birdseye coal and



Section of Storehouse, Watervliet Shops.

will be burned under forced drafts furnished by two 8 ft. fans furnished by the Green Fuel Economizer Co. The stack is of concrete, 9 feet in diameter, 210 feet high, and was built by the General Concrete Construction Company. The ashes are handled by means of an air operated hoist.

In the pump room are located the feed water heater, boiler feed pump, fire pump, hydraulic pump, and the boiler washing equipment.

Stores Department.

The storehouse is located centrally with respect to the roundhouse and main shop, and on a line with the 100 ft. crane runway. This building is of mill construction and is 62 ft. by 162 ft. It consists of three stories and basement and will serve the entire northern division as mechanical storehouse and the entire system as stationary storehouse. The offices of shop superintendent, master mechanic and efficiency engineer, together with the stores department office, will be located in this building. Materials will be handled from floor to floor by means of a 3,000 lbs. capacity elevator. On the north, east and west sides of this building is an 8 ft. platform to facilitate in loading and unloading material, while on the south end is a casting platform 78 by 142 ft. This platform together with that on the east side of the storehouse is served by the general storage yard crane. Tracks run parallel and in close proximity to all of these platforms and the storehouse is also connected to the main shop with an industrial track.

Main Craneway, Watervliet Shops.

Heating and Lighting.

All of the buildings with the exception of the storehouse, the truck shop and the roundhouse, which are heated by direct radiation, are heated by indirect radiation—the heating coils and motor driven fans being located in the roof trusses in the clerestory bays. The shop and yard lighting is accomplished by means of some 200 "Stave" 100 hour flaming arc lamps.

Water Supply and Storage.

Water is supplied to the plant from a concrete lined well 50 ft. deep and 60 ft. in diameter. Two 1,000 gallon per minute centrifugal pumps are used, being operated by 50 H. P. motors. The water is pumped through a 10 inch main to a 60,000 gallon per hour capacity water softener from which it passes into a 318,000 gallon storage tank built by the Des Moines Bridge & Iron Company and a 100,000 gallon elevated tank. Approximately 200,000 gallons of water are available at all times for fire protection for which purpose fire pumps have been installed. The tank for fire service is located back of the power house on a 90 ft. tower and has a capacity of 50,000 gallons. The round house and the hammer shop are equipped with the "dry" sprinkler system of fire protection while all the rest of the buildings are fitted with the "wet" sprinkler system. The water obtained from the well will be filtered for drinking purposes, the New York Jewell-Filteration System being installed in the power house and the supply being pumped from the filter to a 10,000 gallon tank south of the power house and separated from it by the 67½ ft. crane runway.

As will be seen from the accompanying illustrations the construction of the buildings of this plant is such as to permit a great degree of economy and yet provides complete housing to all parts. The placing of the entire locomotive department under one roof offers a great many advantages, chief among which is the fact that supervision is greatly facilitated; also the movement of material, practically all of which is done by cranes, is facilitated and there is an economy in heating, due to infrequent opening of doors and a minimum exterior wall area.

This plant was designed and constructed under the immediate supervision of V. Z. Caracristi, Consulting Engineer of the Delaware & Hudson Co.

The Chicago & North Western's old Wells street passenger station at Chicago, which was completed in 1880, and which has been replaced by the new terminal at Madison and Canal streets, is to be razed to make way for freight terminal improvements, for which the plans have not yet been announced.

THE ELECTRIFICATION of Prussian railroads has, according to the Mechanical World, met with such successful results on an experimental section between Dessau and Bitterfeld, which are situated about 75 miles south-west of Berlin, that it has been decided to extend the electrification of that trunk line to Leipzig, about 20 miles south of Bitterfeld, and to Magdeberg, about 50 miles north of Dessau. From Leipzig the electrification will also run north-west to Halle, about 20 miles, and thence again to Bitterfeld, forming a triangle at that end of the system. Another line will be electrified between Lauban and Konigszelt, which are situated about 150 miles east of Leipzig. In all there will be about 192 miles of road on which electric traction will be installed, using electric locomotives. The enlargement of the Muldenstein power plant in the Bitterfeld lignite district has been commenced, as this station is to supply high-tension alternating current for the whole system.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.

The Master Car and Locomotive Painters' Association of the United States and Canada held its forty-third annual convention at the Albany Hotel, Denver, Colorado, Sept. 10 to 13, 1912, inclusive. J. F. Enright, superintendent of motive power of the Denver & Rio Grande, made the opening address, after which President J. T. McCracken, master painter of the Interborough Rapid Transit Co., spoke briefly.

Maintenance of Steel Cars.

The first report presented to the convention was that of the committee on maintenance of steel cars. This gave the experiences of several master painters. In the discussion, Mr. McCracken stated that the Interborough has five hundred steel cars which have been in service about eight years. The cars were well painted at the beginning of service and the old paint has been left untouched, the cars still being in good condition. The actual cost of keeping the cars in condition is eighteen cents per day.

F. M. Dribble, of the Louisiana & Arkansas, stated that it pays to keep any metal structure well painted, especially steel cars which yield so readily to the ravages of rust, because this class of equipment is exposed to wide atmospheric changes. Rust once given a start will spread in a surprising manner.

Mr. J. Spirk, of the Chicago, Rock Island & Pacific, stated that some of that road's steel gondolas were loaded with hot cinders which burned off the paint and left the steel bare. Corrosion soon set in and the cars were getting into bad condition. Considerable expense was saved, however, by prompt attention. The spots were scraped by steel brushes and washed with benzine, after which a good coat of paint was applied.

F. A. Weis, of the Central of New Jersey, stated that the average cost of sand blasting an 80,000-lb. capacity steel coal car is $11.00, and the average life of the paint is five years. The sheet steel used in the construction of coal cars is ¼ inch and when they rust to ⅛ inch thickness replacement is necessary. A deterioration of about 5 ounces of metal per square foot per year from the inside of steel cars is to be expected from the corrosive action of acids and weather, the inside not being painted. The exterior surface if not painted will deteriorate at the rate of about 3 ounces per square foot per year. If neither side were painted the plates would decrease in thickness to about ⅛ inch in ten years. If the exterior is kept painted the plates will last about 17 years. He puts the cost of sandblasting and painting at about $44.00 per car.

Vestibule End Finish.

The next subject for discussion was "vestibule end finish." C. A. Hubbs of the Southern Pacific spoke in favor of natural mahogany or of birch stained to match mahogany. This gives a cheerful aspect, does not show the dust and is easy to maintain in good condition. If the vestibule is finished in birch when new, no shellac should be applied, as birch contains a sap which causes shellac to peel in a short time. Varnish should be used next to the stain. Few panels and mouldings make the work more economical. The vestibule finish on Southern Pacific steel cars is grain mahogany and varnish.

W. Mullendorf of the Illinois Central said that the interior of a steel car vestibule grained to match the interior of the car is as hard a task to maintain as is a wooden car. He believes that the vestibule interior should be painted and finished the same as the exterior of the car. This is the only way to overcome the difficulties the painters have found in maintaining vestibules. The system has been found the best practice on several systems. It was voted as the sense of the association that the natural wood, stained or grained finish, is appropriate for the interior of wooden vestibules from the standpoint of appearance.

Car Interior Renovators.

The discussion on the subject of "car interior renovators" was started by A. J. Bruning of the Louisville & Nashville. He stated that if the interior of cars is scrubbed every thirty days for two years the varnish will be cut off on the edges. The sills, blinds and sashes will become weather-beaten unless they are gone over after each application of soap and water with a renovator. The renovator should be a light body, non-drying oil, and one which wipes dry and leaves a polish. Cars can also be cleaned with a renovator if taken before the dirt is ground into the varnish.

H. E. Brill, of the Atchison, Topeka & Santa Fe, stated that at terminal points a renovator is very useful, providing the car is thoroughly wiped dry and the corners cleaned and dusted. If this is not done the car will look worse than it did before. The work should be directly in charge of a competent painter, as careless use of a renovator is not only a detriment to the varnish, but makes a heavy job when the cars are shopped.

F. J. Curtis, of the Chicago, Rock Island & Pacific, said that the interior varnish of a car should be cleaned by: first, washing with good soap and water, rinsing off and drying with chamois skin, and second, the renovator should be put on sparingly with white cotton waste and then wiped thoroughly with dry waste.

G. Warlick, of the same road, said that on a car with a polished surface a liquid made of equal parts of renovator and vinegar will give good results. It should be kept well stirred and only a little used at a time. It takes the dirt off the polished work, and leaves it in very fine condition, and it does not require much labor.

J. H. Pitard, of the Mobile & Ohio, stated that in some cases, where the varnish has become dull, the car can be kept in service for some little time with the use of a good renovator. If used before the varnish shows the need of it, it is a waste of money.

C. E. Copp, of the Boston & Maine, said that the nature of the renovator to be used is very important; it should be applied to a clean surface, and should be non-drying, and should not produce a film on glass in a warm room. It should be tested first, and if after standing two or three weeks it shows no disposition to dry, or if the atmosphere evaporates it, it is probably a safe renovator to use. In that case it should be rubbed as dry as possible. He would not apply a renovator on the interior of a car that will produce a film on a test exposure.

There was difference of opinion between T. J. Hutchinson of the Grand Trunk and J. H. Pitard of the Mobile & Ohio on whether the renovator should be an emulsion or a thin liquid, the former recommending the emulsion.

It was voted that the association should go on record as recommending that a competent practical painter be placed in charge of all cleaning of equipment of all kinds at terminal points.

Concrete Car Floors.

Leo H. Nemzek, chief chemist for John Lucas & Company, Philadelphia, Pa., presented a paper on the treatment and finish of passenger car concrete floors. The paper is quoted briefly below:

The proper method of treating concrete is often-times neglected in order to obtain the decoration at the lowest possible cost. Finished concrete will contain a certain amount of quicklime, which has a saponifying action on fatty oils. It is very porous and the expansion and contraction resulting from frequent absorption of water has a weakening effect. The greater the proportion of cement the less will be the absorption qualities and the older the concrete the less capillarity it will have. This should be borne in mind

when applying the filler coat to the concrete. Waterproofing compounds mixed in with the concrete tend to weaken it and the same may be said concerning the materials added for decoration. The colors that have proved the most successful are natural earth pigments, which are practically inert and therefore have no harmful effects. Water soluble dyes have been used to give brilliancy with no harmful effects, but the former are to be preferred, as they are fast color, while the stains invariably fade. It is advisable when contemplating finishing concrete in a color, to write to the suppliers of the cement to learn of the coloring materials which can be safely used.

The absorption of grease and oil not only tends to disfigure a floor, but has a disintegrating action. Many types and grades of mineral oil when allowed to penetrate into concrete that was not thoroughly dry were found to possess a disintegrating influence, but on old surfaces there is no noticeable indication of this. Linseed oil in a concrete mixture does not make it waterproof or make it impervious to the absorption of oils.

The natural grinding action or wear on the surface of a concrete floor will cause a dust which readily adheres to the surface of untreated floors, in a manner which makes it impossible to remove. By painting, the floor is made sanitary, because it may be kept clean and free from all traces of dust and dirt, and oils and grease may be kept from penetrating into the concrete. It is possible to obtain the same color and decoration on concrete floors that is to be had by the painting of wood.

A treatment of the concrete surface which has for its object the elimination of whatever free alkali is present on and near the surface will in practically every instance prove injurious to the concrete. The general results of experiments along this line indicate that it is not advisable to attempt the elimination or change of the alkali to some other form, by chemical reagents.

The most satisfactory results have been obtained by the use of a thin varnish-like mixture which is especially adapted for work of this character. This filler is practically a wash which penetrates into the concrete and destroys whatever action alkali would have on an oil paint coat. In the process of neutralizing any free alkali with which this filler comes into direct contact products are formed, which assist in making a thorough bond within the concrete, without weakening the structure. Capillarity is destroyed by the oxidized film, which results upon drying. The paint coat which follows the filler can then be selected to obtain the desired decoration and will assist in correcting for all the forces that exert deteriorating influences on naked concrete.

Ordinary floor paints which prove satisfactory when used over wooden surfaces give equally as good results when used over a properly applied filler. The wear closely resembles that found on a wooden floor. The paint coat invariably possesses somewhat better bonds within the concrete and the service in many cases is superior to that obtained from the same paint applied on wood.

While it is true in other branches of painting that the application of several thin coats is preferable to thick coats, this method of application is even more necessary for the painting of concrete floors. While good results can be obtained from the application of one coat over a filler, the best service value is given where two coats are used, the first especially being applied thin.

It is not necessary to again apply a filler when repainting floors. One coat of paint applied so that it can be brushed out well will give the best results. In preparing the surface for repainting no strong alkali should be used for cleaning, as it will not only act upon the paint, but if not thoroughly removed will also affect the following coat. It is advisable to go over the surface with warm water and soap, and allow sufficient time to elapse for drying.

Care of Steel Passenger Car Roofs.

T. Spirk, of the Chicago, Rock Island & Pacific, said that when painting steel roofs they should be free from rust and well prepared for the priming coat. That coat must be of solid pigment and pure oil, well brushed on, so that an elastic crust will be formed which will adhere to the steel and become a good foundation for the following coats. The surface must be covered with a solid body of paint, so dampness and cinders will not get to the steel.

E. L. Younger, of the Missouri Pacific, stated that steel roofs should be sand blasted or pickled before painting, to remove all the scale and rust. A passenger car roof receives harder treatment than any part of the car with the exception of the floor, on account of the locomotive cinders, of workmen scarring the paint while making repairs and on dining cars, while ice is being put in the refrigerator. On account of these injuries the roofs should be painted every six months.

J. A. Pitard, of the Mobile & Ohio, said that a good way to remove the scale is by pickling the plate in dilute muriatic acid in a vat. The trouble with steel roofs is not so much from scale as it is from the action of cinders wearing away the paint while the car is in service and on canvas and tin roofs the ends of the cars should be painted with a thick paint containing medium coarse sand to offset the effect of the cinders and it gives good results.

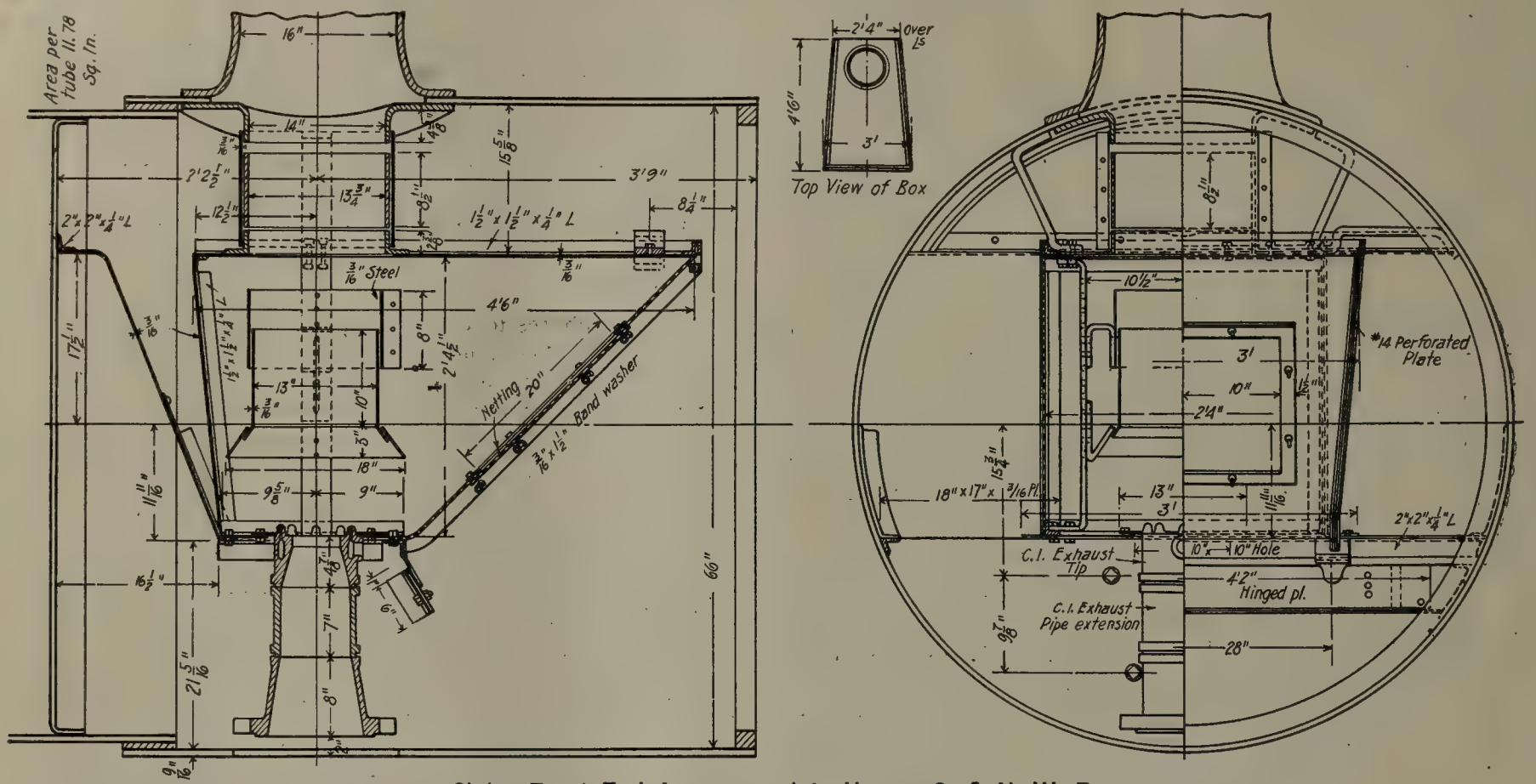
Maintenance of Steel and Wooden Passenger Cars.

John Gearhart, of the Pennsylvania, said that system has up to the present time been getting about 50 per cent more service from the steel than from the wooden cars; in fact, since the advent of the steel car on their lines about the only people yet called on for repair work are the painters and truck repairmen. As to the relative difference in the cost of maintenance on the exterior of cars, after almost five years service of the steel car this maintenance is greatly in favor of the steel equipment. Experience with wooden cars showed that every time a car was shopped for class or slight repairs it was necessary to replace anywhere from a half-dozen to a dozen panels and the same number of battens due to the panels being split or being scraped by baggage trucks, etc., which is all eliminated on steel equipment. On the interior of the steel car more or less trouble is experienced with rust due to acids, etc., used when the cars are under construction. There is also considerable cracking of the paint and varnish. This latter trouble will be overcome in time. There is contemplated a change from air to mechanical drying by installing a baking oven sufficiently large to take care of the largest passenger cars. The maintenance of the roofs on some cars has not cost any more than to coat them over. Everything on a steel car should be sand blasted. In tests it was shown that inside of two years the scale was removing the paint. The cold rolled steel should be sand blasted, for the paint is coming off the inside sheets.

G. Warlick, of the Chicago, Rock Island & Pacific, stated that on that road there are about 200 steel passenger cars and about 1,100 wood passenger cars. The cost for the exterior of the steel passenger cars when they are shopped for class one repairs (which means cutting in and varnishing) is about the same as a wooden car of the same size; the interior of the steel cars is finished in mahogany and oak and receives the same treatment as a wood car and costs about the same for labor and material. There is, however, a saving on the floors of a steel car which do not have to be painted. The cost of painting a car which comes in for "class two" repairs (which means removing the paint by sand blast or other methods) will be about 10 per cent more than for a wooden car; there will also be an additional ex-

pense of glazing or scraping in; you can figure about $8 to $12 for this operation. The roofs will require more care, as they will have to be brushed with a steel wire brush to remove rust and keep them well painted. While there may be, as above stated, more labor on the steel cars, it is turned back into service sooner, which evens up the difference in the cost of maintenance.

O. P. Wilkins, of the Norfolk & Western, said one reason for not sand blasting the roof is that it does not receive the same treatment as the rest of the car. Experience shows that where sand blast is used, and only a few coats of paint are put on, the film is very thin compared with the body of the car and it soon wears through and corrodes. A surface not sand blasted is better after three years than one sand blasted. The sand blasted surface is more or less honeycombed; these little pinnacles that project up through the thin paint wear off and expose the iron and corrosion sets in, and it reaches under the paint.



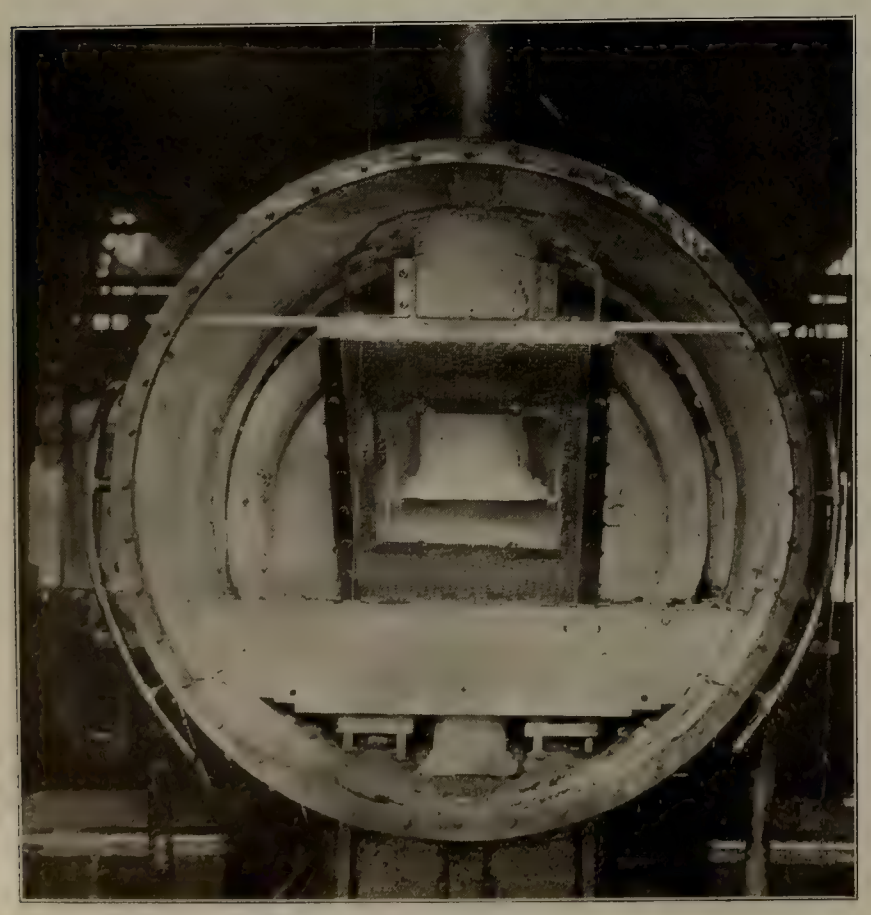
Slater Front End Arrangement in Use on C. & N. W. Ry.

General.

The next place of meeting will be selected from the following three places, Ottawa, Can.; Detroit, Mich., and Chattanooga, Tenn.

J. F. Enright, superintendent of motive power and car department of the Denver & Rio Grande, and Warner Bailey, retired master painter of the Boston & Maine, were elected honorary members.

The following officers were elected: A. J. Bush, Delaware & Hudson, Oneonta, N. Y., president; O. P. Wilkins, Norfolk & Western, Roanoke, Va., first vice-president; T. J. Hutchinson, Grand Trunk, London, Ont., second vice-president, and A. P. Dane, Boston & Maine, Reading, Mass., secretary and treasurer.



Slater Front End Arrangement.

FRONT END ARRANGEMENT.

The illustrations show a box front end arrangement in use on the Chicago & North-Western Ry. which was invented and patented by F. Slater, master mechanic at Escanaba, Mich. It consists essentially of a netting in box shape, surrounding the nozzle, the details of which may be seen in the drawing. The arrangement practically eliminates the throwing of sparks and is especially adapted for lines running through timber lands and districts where it is necessary to minimize danger from fires. The cost of fitting up locomotives with this arrangement is practically no more than that of fitting up front ends in the ordinary manner and it does not affect the steaming qualities of the locomotive. The North-Western has 1,200 engines equipped with this arrangement and they have given excellent satisfaction.

THE BABBITT metal generally used on the Russian South Western railways is composed of 23 per cent tin, 3 per cent gun metal, 24 per cent antimony, and 50 per cent lead. Tests were made with the usual babbitt, and one containing 83 per cent lead and 17 per cent antimony, with results as follows: The usual babbitt, with a specific gravity of 8, showed a hardness of 23, a toughness of 18.1, and a strength of 34; while the new babbitt, with a specific gravity of 10, showed a hardness of 20, a toughness of 17.5, and a strength of 31. The wear of bearings was found to be practically equal, but the new babbitt costs but one-half the old.

ELECTRICAL EQUIPENT OF RAILWAY SHOPS.*

By Geo. W. Cravens.

In these days of the very general application of electric power to the service of man it may seem incredible that there should be very many, if any, railway shops that are not fully equipped with electric power for machine tool drive as well as for lights. And yet, an extended investigation has shown that quite a number of the older roads have not availed themselves very fully of this useful form of energy.

Electrical devices of every sort have been very generally adopted in new shops, for lighting, motors, welders, heaters, drills and other purposes, and in most cases has so far influenced the general layout of new shops as to develop a modified type of shop. This latter point is especially true of the traveling crane. Originally the transfer table was the limiting factor because all shops doing work on assembled cars or locomotives had to be tributary to it. Now the large electric cranes can pick up a heavy car or locomotive and shift it from one end of the shop to the other and from track to track so easily that the transfer is not so much of a necessity as before.

There is no department of a railway shop in which some application of electricity cannot be made, and in most of them it is practically indispensable if economical operation is to be realized. The reasons for this are so well known as to be indisputable, but we might mention ease of control, flexibility, wide application, efficiency, economy as some of the more important. And all of these apply to power, heat and light, although in different degrees. The single characteristic, ease of control, is in itself sufficient justification for its adoption wherever practicable.

Requirements.

Before taking up the matter of determining the electrical requirements of railway shops, let us first consider the matter of general layout. It will be evident to anyone that no two shops can be exactly alike and be equally efficient for its particular purpose, nor can any definite set of rules be laid down which can be followed implicitly when laying out a new shop. On the other hand, experience shows that there are certain general laws which may be used as a guide in studying conditions and will help in formulating the preliminary layout.

The first and best thing to do is to make a careful, comprehensive and detailed study of existing shops, old and new, especially those operating under conditions similar to the assumed conditions of the new one. Any such survey should cover not only the arrangement and equipment of the buildings but also the operating conditions of the road, the organization and management of the shops, the amount and nature of the rolling stock, the general policy of the management, the men behind the organization, the probable future conditions as presaged by present tendencies, etc.

Many other factors might be mentioned but these will suffice for the present. Each road has its own problems to solve and its shops must be planned in the light of the fullest available data to achieve the fullest degree of success. In all cases the arrangement finally adopted is more likely to be the most practicable under the conditions than the ideal one for the work to be done.

The most important single factor, in recent years at least, is the very general adoption of electricity as the distributing medium for the power. This not only allows a central generating plant but makes possible the arrangement and rearrangement of the machine tool equipment to suit varying conditions at comparatively small expense, increases outputs, reduces operating expenses and investment in buildings, line shafting and belts, provides better speed control and lighting, etc.

The factor of next importance in its effect on the general layout is the electric traveling crane, as previously referred to. Then we have the enormous improvements in shop appliances and the adoption of high speed tool steels as factors in the problem. In practically every shop in the world today, railway or otherwise, may be found the good effect of all of these factors. Many old shops have been remodelled or rebuilt entirely since the advent of modern methods and equipment, and others have adopted them in their extensions. And all new shops are being planned and equipped with a view to taking every possible advantage of scientific methods of management as well as the latest and best equipment.

Another important factor, and one which effects the size as well as the location of the main shops, is the comparatively recent tendency to establish small but well equipped shops at large centers and division points in connection with the round-houses. In many cases these can take care of fairly heavy repairs in case of emergency, but in most cases they are planned for running repairs only. Evidently this will relieve the main shops to an appreciable extent and keep the rolling stock, especially engines, in operation during a larger percentage of the time. The influence of this tendency on the main shops will be evident.

We find that most of the shops that are twenty or more years old have either no central power plant, or have one at the side or end of the group of buildings, thus effecting the power distribution. In most cases these old shops have two or more boiler houses scattered about the yards supplying steam to the separate buildings for driving steam engines. Some of these have generators attached, but most of them drive long lines of shafting direct. However, this condition is rapidly passing away so let us see what is being done now.

All general utility buildings, such as the power plant, general storehouse, blacksmith shop, etc., should be as near the center of the group of buildings as possible, although the locomotive shop is the most important and is the controlling factor. A study of recent shop layouts shows a growing tendency to concentrate the buildings along a craneway (the means of communication between the departments) similar to the older method of keeping the buildings along the transfer table, and arranging the shops of each group according to their respective function. The Big Four shops at Beech Grove, Grand Trunk shops at Battle Creek, Lake Shore shops at Collinswood, Frisco shops at Springfield, and a few others are arranged with the craneway as above outlined.

Another very important factor in determining the class of layout is the sometimes unavoidable necessity for arranging the shops along the right of way of the railroad. This usually makes a layout that is not economical or convenient but which is operative by the adoption of electric power. In fact, the further a layout departs from the ideal, the greater is the benefit to be derived from the adoption of electric power in place of an existing steam plant.

Turning now to the electrical requirements, let us see how they are to be determined. From the foregoing it will be evident that the general arrangement of the plant will effect the distribution of power on account of the relation of the departments. The size of the plant will determine the amount of power required, modified of course by the nature and amount of work done. The proportion of new equipment built, as related to repairs, to old rolling stock, will also have its effect.

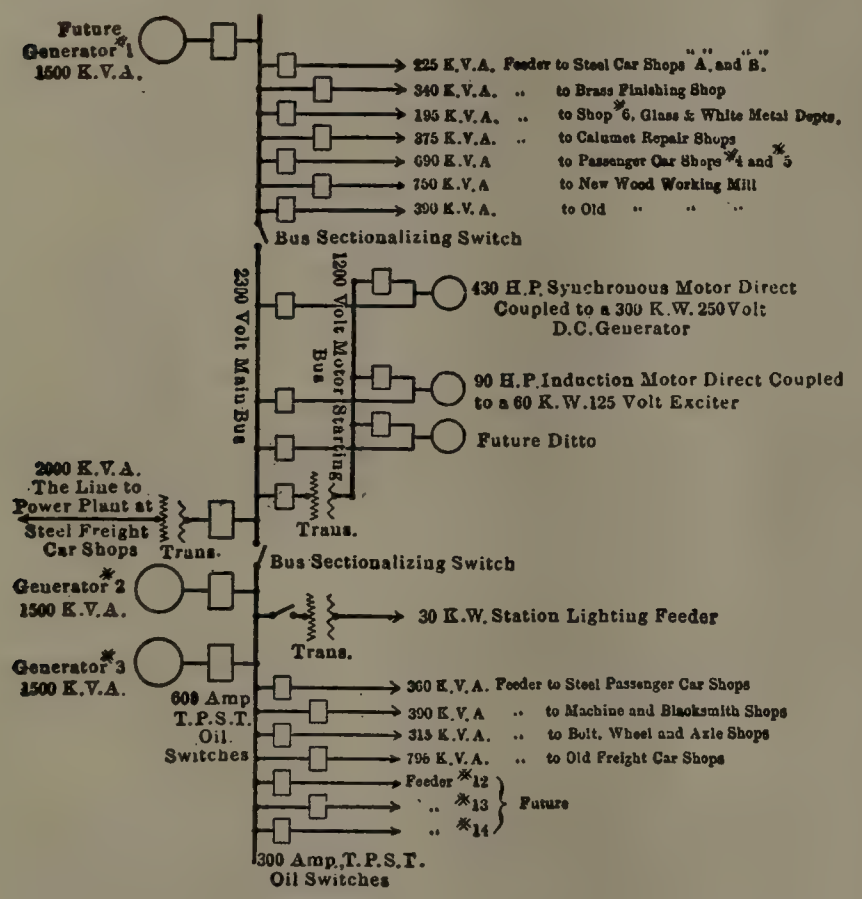
*From a paper delivered before the Western Railway Club, Sept. 17, 1912.

Electrical Equipment.

After having settled all of the preliminary questions, indicated in a general way by the foregoing, the next thing is to prepare a list of the lights, motors, etc., required for each department. The tools needed, consideration of group or individual drive, method of operation and control, kind and number of lights in shops and yards, miscellaneous applications of power such as for heating, welding, etc., all must be taken into account.

A preliminary power diagram should then be made up. This can be a simple skeleton outline similar to the accompanying Power Distribution Diagram of the Pullman Car Shops. A vertical line will indicate the main bus bars and the sources of power can be placed to one side with the uses or applications on the other side of this line. The amounts or values of each element can be filled in after they are determined. It will be obvious that either an alternating or a direct current system may be laid out in the same way, the principal difference being in the use of oil switches and transformers in the a. c. diagram.

As to whether alternating or direct current should be used, there are many different opinions, most of them based upon


Future Generator #1 1500 K.V.A.
225 K.V.A. Feeder to Steel Car Shops "A" and "B"
340 K.V.A. " to Brass Finishing Shop
195 K.V.A. " to Shop #6, Glass & White Metal Depts.
375 K.V.A. " to Calumet Repair Shops
690 K.V.A to Passenger Car Shops #4 and #5
750 K.V.A to New Wood Working Mill
390 K.V.A. to Old " " "
Bus Sectionalizing Switch
2300 Volt Main Bus
1200 Volt Motor Starting Bus
430 H.P. Synchronous Motor Direct Coupled to a 300 K.W. 250 Volt D.C. Generator
90 H.P. Induction Motor Direct Coupled to a 60 K.W. 125 Volt Exciter
Future Ditto
2000 K.V.A. The Line to Power Plant at Steel Freight Car Shops
Trans.
Trans.
Bus Sectionalizing Switch
Generator #2 1500 K.V.A.
30 K.W. Station Lighting Feeder
Trans.
Generator #3 1500 K.V.A.
600 Amp T.P.S.T. Oil Switches
360 K.V.A. Feeder to Steel Passenger Car Shops
390 K.V.A " to Machine and Blacksmith Shops
315 K.V.A. " to Bolt, Wheel and Axle Shops
796 K.V.A. " to Old Freight Car Shops
Feeder #12
" #13
" #14
Future
300 Amp. T.P.S.T. Oil Switches

Power Distribution Diagram of the Pullman Car Shops.

the practical and more or less limited experiences of the users. Probably the greatest part of the argument is caused by the makers of the various motors for commercial reasons. Recent improvements in alternating current motors for driving shop tools have brought them to practically the same degree of flexibility as to speeds as the direct current motor, so practically the only factors now to be considered are the power factor of the system as a unit, slight differences in maintenance and the small drop of voltage in distribution. Further reference will be made to this when considering the power plant.

Having determined the machine tool layout and other factors effecting the amount and distribution of power the next thing to do is to make a complete wiring or power distribution diagram. This may be similar to the Wiring Diagram of the Big Four Shops given herewith, or made in any other way the engineer desires, but this one is the best which has yet come to my attention. All direct current lines are shown heavy because the amount of current is usually large, while the alternating current lines are made light because the current is usually small due to the higher voltages. In either case the diagram should be clear and unmistakable, and as complete a record as it is possible to make.

After the general wiring diagram is finished the details of the power distribution in each building should be taken up separately and worked out in detail. Plenty of switches, fuses, and other cutouts should be provided and all wiring should be well protected. Preferably, all wiring should be in conduits regardless of whether it is on the roof or walls, and brought to the machines under the floor.

Power Plant.

After the equipment of the shop has been determined the main power plant can be laid out and its equipment determined. And right here let us understand that the building must be made to suit the equipment and not the reverse, as is so often the case. Allow plenty of room for convenient operation as well as for extensions. Leave an open space at or near the center of the room, preferably in front of the switchboard, from which the operating engineer can see the entire equipment at all times. You can no more operate a plant safely in the dark than you can read there.

The best location for the power house is undoubtedly as near the center of the load of the plant as possible. This should include ultimate load as well as present load, in so far as they can be determined. This is especially true of direct current plants on account of transmission losses, due to the general use of lower voltages than with alternating current. The easy and adequate supply of coal and removal of ashes must be considered and these frequently influence both the location and design of power houses.

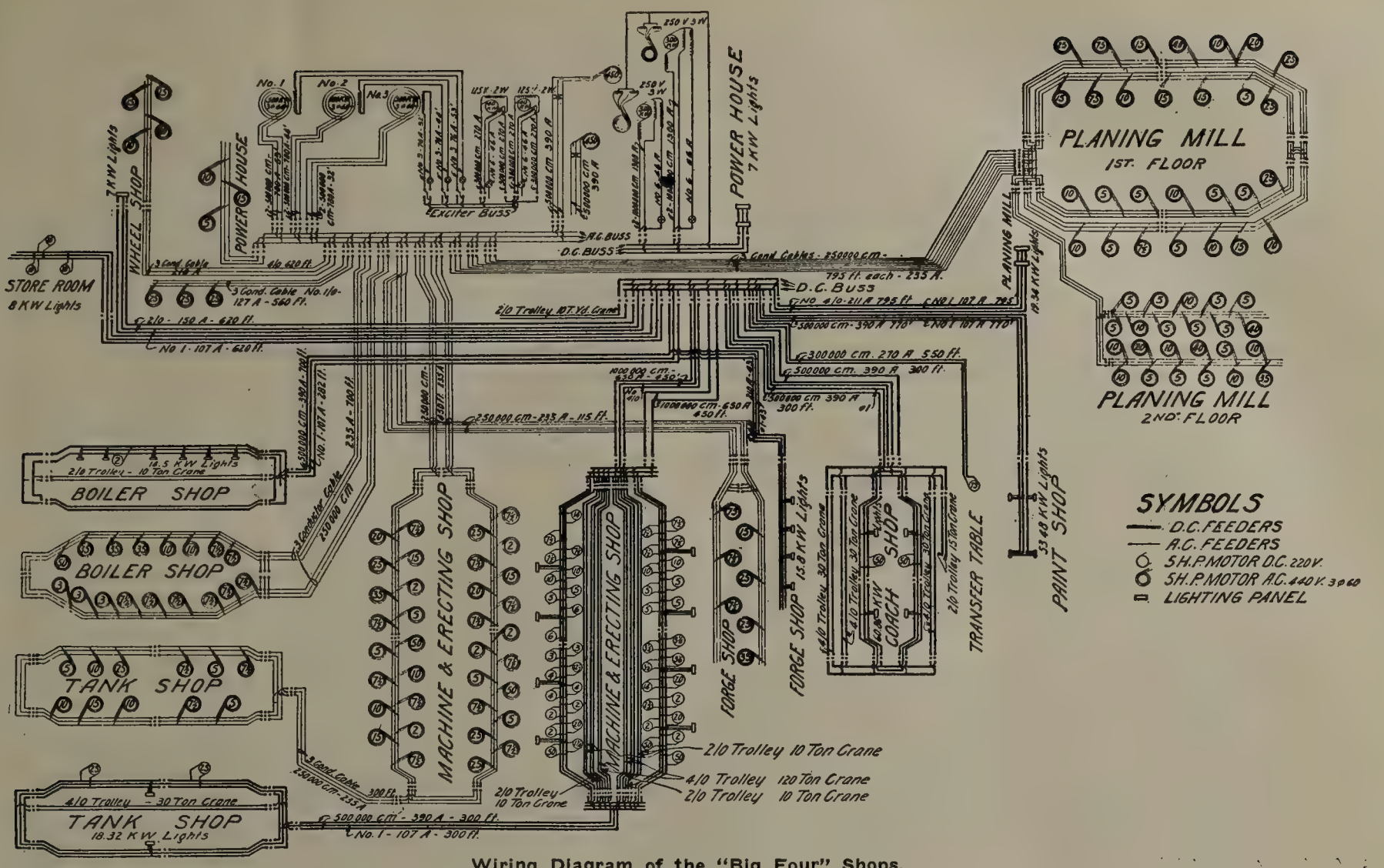
Coal should, preferably, be dropped down through the car floor to a track hopper between the rails (or equivalent arrangement) thence to a conveyor and up to bunkers overhead in the boiler room, for feeding down through spouts to the stokers. From the grates ashes should drop into a hopper which can be emptied into the conveyor again, and carried to an ash hopper overhead ready to be run through a chute to empty cars outside for removal. An equipment like this will soon repay its cost in operating expenses saved. As to the type of boiler to use there is very little choice between the various water-tube boilers now on the market, the fire-tube boiler being practically superseded now for plants of any size.

As to whether reciprocating steam engines or steam turbines are better for power plants for railway shops there is considerable difference of opinion. Recent tendencies in turbines are toward the horizontal type of turbine, running at high speeds in order to get a lower cost generator, although the larger plants use the vertical type to reduce the floor area covered.

The use of steam turbines for railway shops (or any others requiring steam for heating) on account of their large size and amount of glass radiating surface, makes the expense of steam supply a very important consideration. Where non-condensing reciprocating engines are used, or even condensing engines with suitable auxiliaries, together with a good exhaust steam heating system, the cost of heating becomes a comparatively small factor of expense.

The switchboard is a very important part of the power plant equipment, much more than some engineers seem to realize if we judge from some of the switchboards now in use. It should contain not merely panels enough for all of the generators and feeder circuits, but every panel must have a complete equipment of meters, switches, etc., to allow the fullest knowledge and control of conditions in each circuit. A few dollars more spent on the switchboard will usually result in great benefits in the operation of the shops.

As to whether alternating or direct current should be used it really makes very little difference, as previously



Wiring Diagram of the "Big Four" Shops.

stated. If the power is to be transmitted for any great distance the voltage should be as high as possible for safety in a shop, in order to reduce the amount of copper required in the lines and to keep the terminal voltage up to as near normal as possible. Either a. c. or d. c. distribution can be made at 440 volts and this is high enough for any shop at present constructed, if the power plant has been properly located.

Distribution of power to the various shops may be done through overhead or underground cables, the present tendency being to construct tunnels through the yards and to have all steam, water and air pipes and electric cables in them. This makes frequent inspection easy and results in fewer cases of trouble due to breakdown. Overhead lines are carried along the buildings in many of the older plants and on wooden poles in others, with steel poles now being used in some of the new ones.

At the West Albany shops of the New York Central Lines all wiring is on steel towers, separate cables and wires being run from the feeder panels in the power house to each point of application of the power. This is an unusual and extreme case, the rule being to run a comparatively heavy feeder to a distribution center in each building and dividing there into several local circuits. At some shops using alternating current, transformers are located outside of each shop to reduce the transmission voltage to that of the motors and lights in the shops. Distribution panels inside control the local circuits in the usual manner.

Electric Motors.

Assuming that the mechanical department has determined the sizes, quantities and types of machine tools required for the shops, let us now consider briefly the motor equipment. There is no room for argument as to the use of anything but electric motors where they are at all applicable, and that means practically any place where power is used to produce motion. Among the benefits to be derived from their use in driving machine tools may be mentioned decreased transmission shaft losses, increased production through easy speed control, accurate knowledge of power required for any given purpose, ease of power control and distribution, flexibility of machine arrangement, reduced vibration of buildings and machines and the elimination of most belt trouble.

Continuous-current or direct-current motors are usually designed for use on constant potential circuits, three kinds being available for driving machine tools: series-wound, shunt-wound and compound-wound. Each of these has its field of usefulness, as well as its limitations, and will be described in detail as we go along. Direct current motors for use on the multiple-voltage system are also made but are not in very general use on account of the comparatively complicated controllers required. It is also necessary to use a motor large enough to deliver full load at the lowest voltage, which makes this system more expensive to install.

Alternating current motors are also usually designed for use on constant voltage systems and are of two kinds, synchronous and asynchronous. That is, they are designed to run at a fixed speed in the first case or at varying speeds in the second case, the latter finding the widest application in machine shops. Motors of this kind may be obtained for operation on single-phase, two-phase or three-phase circuits, the single-phase and three-phase being the most used. For variable speed work the three-phase motor is better, the asynchronous or induction motor finding the widest application. However, these motors have their good and bad points and will also be considered in detail as we progress.

Without going too much into the details of design and construction of the various kinds of motors, let us consider the operation of the different types.

When a motor is running the quantity of current passing through its armature is limited by two things, the resistance of its windings (which is constant) and the "counter electro-motive force," (tending to choke back the current

through setting up a "counter" voltage in the conductors), this counter e. m. f. being proportional to the product of the field strength and the armature speed. When multiplied by the current flowing, the counter e. m. f. represents most of the active energy in the motor.

A series motor is one in which the current is caused to flow first through the armature windings and then through the field windings before passing back to the line, hence the field strength will vary with the amount of current passing through the armature and the speed will vary to correspond, but inversely as the field strength.

Hence, if we have a series motor running under a certain load the speed and torque or pull will be steady. If we reduce the load the speed will immediately increase because less torque is required. But, the increased speed will increase the counter electromotive force which will in turn reduce the amount of current flowing. This will weaken the field and compel the motor to run faster in order to generate the same counter e. m. f. as before, so the motor races or "runs away." That is why series-wound motors are not so well adapted to driving machine tools as the others. They are good, however, for cranes, hoists, locomotives and other places where they are under the control of an operator at all times.

Shunt-wound motors are so built that the field windings are connected directly across the line, thus providing for constant field excitation and strength at constant voltage. The armature is in series with the line and the current varies with the load. The armature resistance is very low, and causes but small drop in the voltage through resistance, hence the counter electro-motive force must be almost as high as the impressed e. m. f. or line voltage at all times, and the speed will therefore be practically constant. The speed of a shunt motor can be varied through a wide range very easily, although the torque depends solely upon the amount of current passing through the armature windings.

Compound-wound motors are a combination of the two types just described, having both series and shunt connected windings in their field coils. They start with comparatively high torque, like series motors, because of the series winding, but the high speed is limited by the shunt winding so they will not run away under no load. The speed may be adjusted at any desired point with a given load, but it will vary slightly with the load due to the series winding.

The speed of a motor may be varied in different ways, all of which are based upon changing the effective voltage applied. By placing a variable resistance in series with the armature the speed may be varied from full speed to zero, but this is wasteful of energy and reduces the torque of the motor. With shunt and compound wound motors, the better and customary way is to connect a rheostat in series with the shunt field winding. With properly designed motors this method allows variations of four to one in speed; that is, a reduction of 25% of full speed at constant torque.

It will be evident from the foregoing what kind of motor to use for the various classes of service. For instance, suppose you had a planer to equip and attach a series motor to it. What would happen if you tried to plane off the bosses of a large base casting? When cutting metal your motor would slow down, due to the load, but when passing free from one boss to the next your motor would speed up, and when the cutting tool struck the next boss something would break. Experience shows compound motors to be better suited to this service, and so down the list.

Series-wound motors, as previously stated, are best adapted for use where the operator has the motors always under his control, as for hoists, cranes, elevators, locomotives and other classes of intermittent service. The speed of a series motor can be varied only by dissipating energy in the form of heat through a resistance in series therewith, thus reducing the impressed voltage and, in turn, the amount of current reaching the motor.

Shunt-wound motors, because of their speed characteristics and ease of control, are particularly well adapted to driving machine tools. On the other hand, experience shows them to be best fitted to drive tools which do their work with a rotary motion of either the work or the cutting tool. This includes drill, lathes, boring mills, milling machines, etc., rather than machines with a reciprocating motion like planers, etc. For the service stated there is nothing better than a shunt-wound, variable speed motor with good inherent speed regulation.

Compound-wound motors are best suited for driving planers, slotters, shapers, rolling-mills, punch-presses and other machines with a reciprocating motion of either the tool or the work. This is due to the fact that the greatest demand for power is at the instant of reversal of motion, and the series winding causes an increase of torque as the speed drops due to the increased load at this instant.

The load curve of a compound motor may be greatly smoothed out by adding a flywheel, and it will tend to save the motor. For machines of the class stated, motors of larger capacity are required than for machines operating with a rotary motion and removing the same amount of metal, so fly-wheels will tend to reduce the size motor required for a given machine.

Alternating current motors are also built in a variety of forms and some of them possess certain advantages over direct current motors for special classes of service. Synchronous motors operate at constant speed regardless of load, up to the stalling point, so long as the speed of the generator driving them remains constant. But they require the separate excitation of their field windings with direct current, the same as an alterating current generator, so are seldom used in machine shops except in the larger sizes. They may be used, however, where constant loads are to be carried at constant speeds, such as for blowers and pumps operating continuously, and for driving generators which operate at constant potential. There should always be one in plants using induction motors for power in order to bring up the power factor.

Induction or asynchronous motors are of two general types, those with "squirrel cage" or short circuited armature windings and those with armature resistance external thereto for speed regulation. The latter class is further subdivided into two styles, those with the resistance elements mounted inside the rotor, or armature, and those with contacts, or "slip rings," on the armature and leads running to resistances mounted elsewhere. Small sized induction motors are nearly always of the squirrel cage type with the primary windings only connected to a circuit. The only way to change the speed of such motors is through voltage variation through transformers or resistances, and this effects the torque of the motor.

The no-load speed of an induction motor is practically synchronous with that of its source of supply and its full load speed from 3 to 15% less, depending upon its size. In order to develop torque an induction motor armature must "slip" or fall behind the synchronous speed, and the amount of this slip varies directly with the load and the resistance of the armature, and inversely as the square of the voltage applied.

The running torque is directly dependent upon the resistance of the armature, the slip and the square of the voltage, while the maximum torque is independent of the rotor resistance. Induction motors with external resistance as described will operate at full-load torque with the speed reduced as much as 50% without overheating.

Induction motors with squirrel cage rotors are suitable

for use where speed variation is unnecessary during a given operation, such as for pumps, fans, drills, grinders and other places where motors with the characteristics of shunt-wound direct current motors are required. Speed variation, however, can only be obtained through varying the voltage or with speed changing gears on the machine, both of which are undesirable. Squirrel cage motors are good for use in oil houses, wood-working shops and other places where inflammable materials are found as there is no moving contact and no sparking.

Induction motors with variable secondary resistance, on the other hand, may be run at speeds of anywhere between half speed and full speed, at full load, and are suited to most any class of service that either shunt or compound direct current motors are. Recently a new form of induction motor has been brought out for use on planers and other machines requiring a reversible motor. This motor is so designed that it will stop from full speed, reverse and come up to full speed again in the time ordinarily taken to shift the belt on a planer, and its switch is operated by the dogs on the planer bed.

Reliable data as to the power required to drive the different classes of machines is very hard to obtain from outside your own shop, so the best thing to do is to get a large motor and attach it to the machine in question and test it. Several reliable makes of graphic meters are now on the market and a great amount of benefit is resulting from their use. Tests conducted under various conditions of operation have been made by several of the railroad companies in their shops and very valuable data has been compiled. In many cases the size of motor recommended by the machine tool maker has been found much larger than necessary and money has been saved as the result of making the tests.

Some time ago Prof. Flather conducted a series of tests to determine the power required to drive machine tools when cutting various metals, and he found that the results agreed very closely with the following formula:—

HP = F X D X S X C.

Wherein—

F = feed in inches,

D = depth of cut in inches,

S = cutting speed in inches per minute,

C = a constant whose value depends on the material worked.

If more than one tool is cutting at one time, the power required will increase in proportion to the number working.

The values of C are as follows:—

Cast Iron	0.35 to 0.40
Soft Steel and Wrought Iron	0.45 to 0.50
Hard and Machinery Steel	0.70 to 0.80
Crucible Steel	1.00 to 1.10

Based upon the weight of metal removed in pounds per minute, the above formula can be changed to the following:—

HP = F X D X S X W X K.

Wherein most of the symbols carry the same meanings as before, the others being W = weight per cubic inch of the metal being worked on and K = HP coefficient for that kind of metal, as given below:—

Hard Steel	2.65 HP
Soft Steel and Wrought Iron	2.40 HP
Cast Iron, Hard	1.36 HP.
Cast Iron, Soft	1.00 HP.

The weights of the various metals as used in the above are as follows, in pounds per cubic inch:—

Steel	0.284
Wrought Iron	0.278
Cast Iron	0.258

It will be noted that the figures given as the values for the constant K equal the actual horse power required at the motor for each pound of metal removed per minute, regardless of the rate of cutting. A number of tests showed these figures to be remarkably close where the machines were in good condition and adapted to the work.

It must not be thought that the cost of electric power for operating a shop will be the equivalent of the full load capacity of all of the motors installed, for that is not the case. Figures based upon the records of nearly 200 shops which have come to my attention show the average load to be but 30% of the rated capacities of the motors installed. There are over 2,500 motors in these shops averaging slightly over 7 HP each, but the majority of them are smaller. The cost of maintenance of these motors averages from 15% to 30% of the former cost of maintaining belts in these same shops, and the other benefits are almost incalculable.

When the matter of adopting electric drive is being considered an experienced engineer should always be consulted to avoid mistakes. No other one thing has caused so much adverse criticism of electric motor drive as the errors which have been made, by many managers and superintendents, through assuming that they knew what to do without making a careful and thorough study of conditions before making radical changes in their shop equipments. Each shop presents conditions and problems of its own, but all of the necessary information can be obtained by taking time to go into details carefully and studying every step from the coal pile to the cutting tool. And one of the most important things of all is a good set of accurate records of time, operations, materials, machines, men and methods, as well as of whether individual or group drive is going to be best for any department or the entire shop.

Shop Equipment.

In the light of what has been said regarding the various types of electric motors and the kinds of tools they are best adapted to drive, let us now consider the equipment of the various shops and departments. The locomotive machine shop is the most important one in most shops so we will consider that first. These shops usually have all of the machine tools in a single section or bay at one side of the erecting bay, although some shops have two machine bays and others have two erecting bays. The machine tools are usually driven by individual motors if very large and in groups if small, especially in the older shops. This is evidently an error due to a mistaken notion of where the line should be drawn.

At the present there is a tendency towards increasing the number of machine tools per pit. The average is between 6 and 8 per pit with many shops having from 5 to 6, but the tendency is towards from 8 to 10 per pit in several recent shops. When the full effect of scientific methods of management have been realized it may be possible to return to the old proportion of 5 to 6, and still turn out more work in a given time. As to how many tools of each kind will be required there is no fixed rule, but a survey of the field shows the following proportions in existing shops:

Percentage of Tools of Each Type Per Erecting Pit.

Turning Tools	50%
Cutting Tools	25%
Drilling Tools	11%
Grinding Tools	7%
Miscellaneous	7%

A short time ago a table was published in one of the railway papers giving the number of machine tools total and of each class per erecting pit, and this showed the average to be slightly over 9 tools per pit. The table is as follows.

Machine Tools of Each Class Per Pit.

Lathes	3.925
Boring Mills	.875

Planers	1.00
Shapers	.5
Slotters	.458
Millers	.375
Drills	1.083
Grinders	.666
Miscellaneous	.708
Total	9.59

Various tables have been published showing the number of tools of each type and size for different numbers of pits, but they are usually more interesting than valuable because of the differences in local conditions. The table above is merely a guide and not a safe and invariable rule, although it is based upon average shops. For boiler shops the average is about one tool for every pit in the erecting shop, there being seldom more than one tool of each kind aside from drills and shears.

The policy of the mangement regarding the stocking of repair parts and the degree to which standardization has been carried have a great influence upon the number of machine tools required. More tools will be necessary to get work out in a hurry if the stock is too small and fewer tools will be required for ordinary operation if parts are standardized fully. Special machines may be used also if parts are standard.

Freight and passenger car shops do not require much machinery as they are primarily assembling and painting departments. But, the upholstery department uses motor driven sewing machines, the tin shop uses some few motor driven tools like shears and rolls, the finishing shop uses wood sanding and working tools, etc., but the majority of the work done on cars is by hand. The truck department is usually a part of the general machine shop, but not always. Small hoists and electric lights are used quite extensively, of course, both arc and incandescent lamps being used. Motor driven ventilating fans are also used at times, although the majority of car shops are so constructed as to require no artificial ventilation. For small portable tools, such as drills, polishers, paint sprayers, etc., the wiring should be carried in conduits with outlets at frequent intervals. These outlets are usually receptacles mounted on the posts and columns.

Aside from the cranes and a few motors for driving punches, fans blowers, shears, etc., there is not much electrical equipment in a blacksmith shop. For lighting, the flaming arc lamp is popular because the rays penetrate the smoke better than others, but Tungsten lamps in clusters with enclosing globes are being used to an increasing degree. The use of oil in place of coal for the furnaces in helping this along, also. Overhead motor driven cranes are also superseding hand operated jib-cranes in these shops.

Foundries are more commonly found in railway shops than formerly and so are wheel shops for chilled wheels. These have electrically operated cranes and small cars, motor driven tumblers, grinders, chippers, etc., and are lighted by flaming arc lamps as a rule. Cranes of 10 tons capacity are most commonly used in railway foundries, with hoists of from one to five tons in the side bays. Pattern shops are sometimes made a part of the foundry building and sometimes kept entirely separate or made a part of the wood mill. The machines are usually motor driven in groups in the older shops and individually in the later shops.

The amount of power required to drive many wood working machines has resulted in most of them being fitted with individual motors. This is also an advantage because of the intermittent nature of the service. For this purpose the induction motor has some advantages over the direct current motor on account of the freedom from sparking. The constant speeds make variable speed motors unnecessary also. The equipment consists of planers, saws of various kinds, mortisers, tenoners, moulding machines, boring machines, gainers, matchers, etc. Lighting is generally done with a few enclosed arc lamps for general illumination with drop lights at the few tools requiring it. Provision for carrying off shavings and saw dust by blowers driven by electric motors is made in new shops, some of the old ones still following the practice of having men clean up the floors. The blowers take the shavings, etc., direct to the boiler room for burning.

Aside from the shops mentioned the applications of electric power around railway shops is limited to special applications, unless we except turntables, yard cranes, motor driven pumps and hoists, yard lights and such simple applications. A special application which is becoming so common as to hardly be special now is the use of electro-magnets for picking up iron and steel. These are made in quite large capacities now and are used for handling plates, rails, bars, pig iron, kegs of small parts, and for lifting the "skull crackers" in the scrap yards. Receptacles are placed at intervals about the yards in some cases so the electro-magnets can be shifted from place to place as required and attached by flexible leads. The round houses, sand sheds, water towers, private hospitals, coaling stations, store houses, and other small departments have their own special applications of electric power, also.

Lighting.

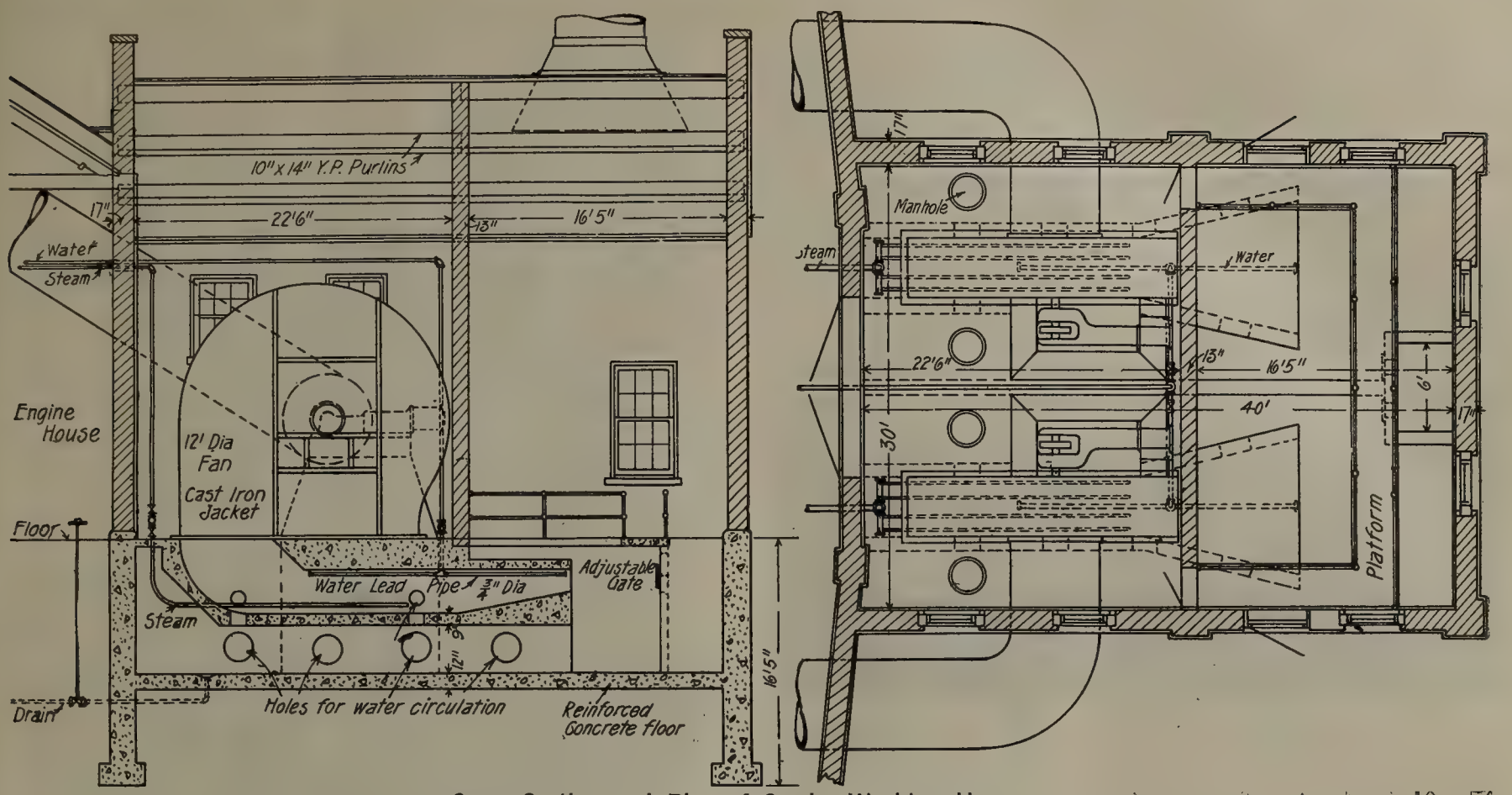
For the offices, drafting rooms and stations the indirect system of lighting is coming forward rapidly on account of its efficiency and very pleasing appearance as well as its freedom from glare. Carbon filament lamps stand the handling as drop and portable lights better than the tungsten filament, although the new drawn wire type is much more rugged than those first made. Guards should be placed on all portables to protect them and to reduce the danger of fire.

For large areas, such as locomotive machine shops, foundries and yards, the flaming arc lamp is best suited because of its high power and great penetrative ability. Mercury vapor lamps are used to some extent in medium sized shops and power plants, and tungsten lamps of various capacities, singly or in groups, are used to an increasing extent in machine shops, mills, power plants and many other places where there is no smoke to penetrate.

The best system of illumination for large shops is a combination of flaming arc lamps for general illumination with tungsten clusters for group lighting and incandescent drop lights for machines. The individual lighting of machine tools is very important and is receiving more attention now than formerly. Good lighting consists in throwing the light on the work and not in the eyes of the worker. Any system which will do this and supply light enough to see clearly cannot be a very bad system, even though it be not perfect.

Flaming arc lamps make good illuminants for yards and roadways about the shops and plenty of them should be installed to prevent accidents. This is especially important where switching is being done at night if pedestrians are passing. They are also best in foundries on account of the smoke in the air, as also in blacksmith shops.

THE REPORT of the Missouri Pacific, presented to the board of directors in September by President Bush showed quite conclusively that his administration has been beneficial and that he is putting the property on a sound basis as was expected when he took charge. The total operating revenue was $54,503,250, an increase of 3.27 per cent, in spite of a loss in passenger revenue of over $250,000. The operating expenses show a decrease of 4.73 per cent and the net operating revenue was $13,222,658, an increase of 40 per cent. The net income shows a gain over last year of more than $3,250,000.



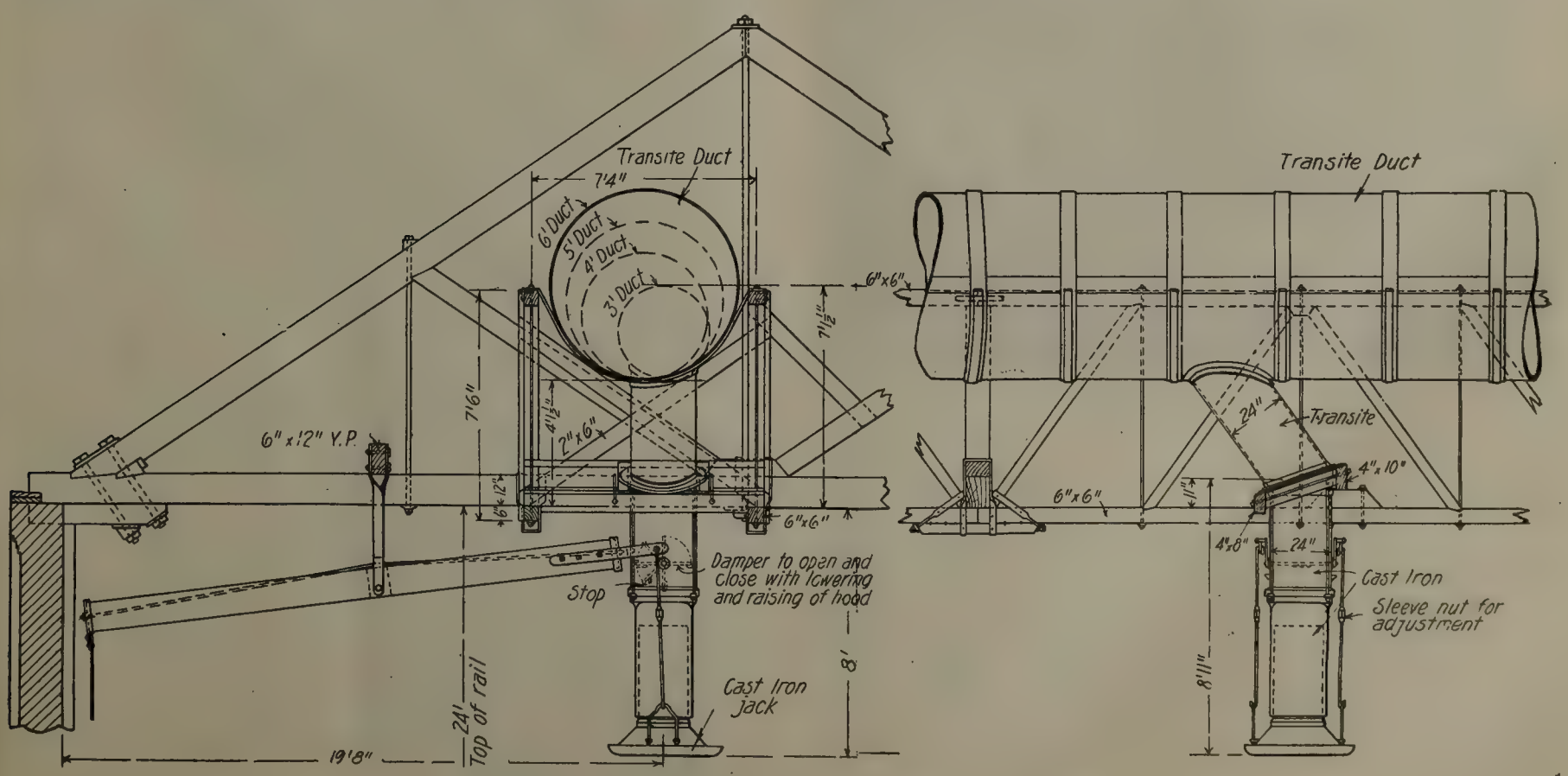
Cross Section and Plan of Smoke Washing House.

SMOKE WASHING DEVICE.

The problem of the elimination of smoke is one in which both engineers and the public are at present very much interested, and in large cities, railroads have come in for more than their just share of criticism. This has been true not only of locomotives in service, but of locomotives while housed in roundhouses. Smoke inspection is becoming more rigid each day, and in constructing a new roundhouse at Englewood, the L. S. & M. S. found that they had to contend with the city authorities on the smoke problem; therefore, it was necessary to devise some method to eliminate or greatly minimize smoke at this point. To accomplish this, the Foster smoke washer is being installed, and it is expected that this will overcome the difficulty. This washer has been patented by O. M. Foster, M. M., of the Lake Shore at Elkhart, Ind., and has been operated for some time experimentally in washing smoke from a locomotive. Recently, also, a permanent plant was constructed at the Collinwood shops for washing the smoke from the power plant at the engine house, and its use there has been very satisfactory.

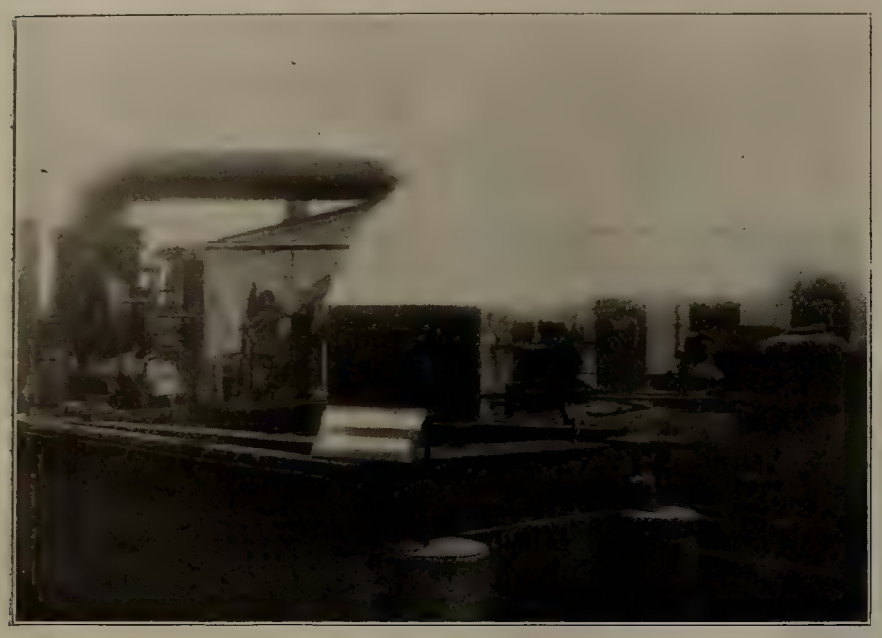
The basic idea of the apparatus is in forcing the gases through highly agitated water which absorbs a large percentage of the impurities. At the Englewood roundhouse gases are conducted from the stack of the locomotive to a duct which runs around in the superstructure of the roundhouse. This duct is of "Transite," and is manufactured by H. W. Johns-Manville Company. The lower end of the jack, which leads to the duct, is of cast iron and is telescopic and counterweighted, so that it may be dropped down tight over the top of the stack. When this cast iron jack is lifted off from the stack, a passage way to the duct is automatically closed by a damper. This is shown in the figure.

Adjoining the outer wall of the roundhouse, is constructed



Showing Smoke Duct and Jack, Englewood Roundhouse.

the smoke washer building made out of concrete. Here are located two 12 foot fans. These fans draw the smoke and gases from the duct which encircles the roundhouse, and force it into a chamber underneath which is shown in cross section in one of the illustrations. In this chamber is installed the steam pipe which injects steam at a high pressure in the direction of the



Experimental Smoke Washing Plant—After Washing Smoke.

flow of the gases. This pipe is near the bottom of the chamber, while near the top is located a water pipe which is perforated in order to allow for a thorough defusion of the water. This chamber is kept entirely filled with water, and the agitation produced by the entering steam together with the water which enters in a spray, allows of no chance for the gases to pass through without being thoroughly mixed with the water. This is further facilitated by the fact that the chamber narrows down very materially just before the gases are discharged into the chamber and stack. A cross section of the smoke washing building and the chamber beneath the fan may be seen in the accompanying illustration. In July of the present year a num-

Experimental Smoke Washing Plant—Before Washing Smoke.

ber of tests of the liquid in the plant at Collinwood were made, the results being as follows:

	Sample A.	Sample B.
Dissolved solids	200.4 grains per gal.	210.1 grains per gal.
Calcium sulphate	107.5 grains per gal.	106.5 grains per gal.
Free sulphuric acid..	55.7 grains per gal.	55.6 grains per gal.

The liquids in these tests were found to be more concentrated than those collected from the washer a year previous. In sample A there was a slight amount of sediment. Sample B, however, was found to contain the following: Oil and pitchy material, 7.15 per cent; ash, 19.16 per cent.

POWERFUL PACIFIC TYPE LOCOMOTIVES, FRISCO LINES.

A theoretical tractive power, 1,000 pounds greater, at 50 miles per hour than the average at that speed for other locomotives of the same type of approximately the same weight is a feature worthy of particular notice and which combined with an ample boiler capacity to deliver its calculated power at that speed makes the design of the Pacific type locomotive built by the American Locomotive Co. for the Frisco Lines, one deserving of careful study. This locomotive is illustrated herewith.

A comparison between the tractive powers at various speeds from starting up to 50 miles per hour of the Frisco locomotive and the average for 5 other representative Pacific type locomotives of recent construction of approximately the same weight is given in the following table:

Theoretical Tractive Power
(Per A. L. Co.'s Formulae)

M. P. H Speed	Frisco.	Average of 5 Pacifics of approximately same weight as the Frisco.	Difference in tractive power in favor of Frisco Pacific. Pounds.	Per Cent.
Starting	40,800	34,140	6,660	19.5
30	24,760	22,670	2,090	9.2
35	21,210	19,540	1,660	8.6
40	18,560	17,110	1,450	8.4
45	16,440	15,200	1,240	8.1
50	14,660	13,650	1,010	7.4

These tractive powers are calculated in accordance with the American Locomotive Company's adopted practice which employs speed factors based on the piston speed in feet per minute corresponding to the speed in miles per hour. The average weight of the five Pacific type locomotives mentioned above is 255,500 pounds as compared with 260,500 pounds, the weight of the locomotive here illustrated. The lightest weighed 9,000 pounds less than the Frisco engine and the heaviest 1,500 pounds more. Of the five, three used superheated steam the same as the locomotive under discussion. The tractive powers given in the above table may consequently be considered conservative; as the American Locomotive Company's speed factors apply particularly to locomotives using saturated steam. From recent tests they appear to be somewhat low for locomotives equipped with fire tube superheaters. With its 69 inch drivers, the Frisco locomotive would not be particularly well adapted to some classes of modern fast passenger service in which speeds of 60 miles an hour and over obtain. Within the range of speeds covered in the table, however, the comparison indicates a well balanced design, carefully worked out. With its large tractive power at speeds of 40 and 45 miles per hour, the design would seem to be also well adapted to fast freight service on moderate grade records. Twenty of these engines have recently been delivered to the St. Louis & San Francisco Railroad. They were built entirely to the railroad company's specifications which included a number of new features first introduced into American locomotive practice by the builders which are being quite extensively adopted and specified by the various railroads throughout the country. Among these will be noticed the steam pipes arranged to connect with the cylinders outside of the smoke box, the self-centering guide for the valve stem and the outside bearing radial truck with floating yoke spring guide and universally flexible spring supports.

The unusually large tractive power at high speeds results from the maximum starting tractive power of 40,800 pounds which is provided. With 158,000 pounds on drivers, this gives a factor of adhesion of 3.87 which is well within the limits of good practice.

Pacific Type Locomotive, St. L. & S. F. R. R.

The boiler is of the extended wagon top type with a minimum diameter of 75⅝ inches and a maximum diameter of 85½ inches. It provides a total heating surface of 3,676 square feet with a superheating surface of 758.6 square feet.

Assuming that the locomotive will deliver a tractive power of 14,660 pounds at 50 miles per hour, as shown in the above table; this would mean 1,950 indicated horsepower. At a rate of steam consumption of 21.6 pounds per indicated horsepower per hour, a conservative average figure for a superheater engine, even when not worked to its capacity, and including steam used in cylinders and air pumps and losses through safety valves, this would mean a water consumption of 42,206 pounds or 11.4 pounds per sq. ft. of heating surface per hour. Except with a poor grade of coal, the boiler should be able to maintain this rate of evaporation at 175 pounds boiler pressure, the working pressure employed, without the least difficulty.

Assuming a fuel consumption of 3¼ pounds per indicated horsepower per hour, the rate of combustion with the 50.9 sq. ft. of grate area required to maintain the above capacity would be only 122 pounds per sq. ft. of grate area per hour.

Following is a table of dimensions:

Cylinder, type simple piston; valve diameter	26 in.
Stroke	28 in
Track gauge	4 ft. 8½ in.
Tractive power	40,770 lbs.
Wheel base, driving	12 ft. 6 in.
Rigid	12 ft. 6 in.
Total	33 ft. 1 in.
Total, engine and tender	64 ft. 9 in.
Weight, in working order	260,500 lbs.
On drivers	158,000 lbs.
Engine and tender	421,700 lbs.
Heating surface—	
Tubes, 5⅜ in.	896.5 sq. ft.
Tubes, 2 in.	2,575 sq. ft.
Firebox	204.28 sq. ft.
Total heating surface	3,675.8 sq. ft.
Total superheating surface	758.6 sq. ft.
Grate area	50.9 sq. ft.
Axles—	
Driving journals, main	10½ x 13½
Others	10½ x 13½
Engine truck journals, diameter	6½
Length	12
Trailing truck journals, diameter	8½
Length	14
Tender truck journals, diameter	5½
Length	10
Boiler—Type, extended wagon top—	
Outside diameter, first ring	74 in.
Working pressure	175 lbs.
Fuel	Bitum. coal
Firebox—Type, wide—	
Length	108 in.
Width	68½ in.
Thickness of crown	⅜ in.
Thickness of tube	½ in.
Thickness of sides	⅜ in.
Thickness of back	⅜ in.
Water space, front	4½ in.
Water space, sides	4½ in.
Water space, back	4½ in.
Crown staying	Radial
Tubes, material, seamless steel No. 247, diameter	2 in.
Length	20 ft.
Gauge	No. 11 B. W. G.

Flues (superheater), material, seamless steel—
Number 32
Diameter .....5⅜ in.
Gauge .....9 B. W. G.
Boxes, main driving and others.....Cast steel
Brake, driver .....New York
Brake, tender .....New York
Air signal .....New York
Brake pump .....No. 6 Duplex
Reservoirs .....1—20½x42; 1—20½x60; 1—24½x60 in.
Engine truck—
Four-wheel swing motion, 3-point suspension hanger.
Trailing truck .....Radial with outside bearing
Exhaust pipe, single; nozzles.....5¾, 6 and 6¼ in.
Grate, style .....Rocking
Piston, rod diameter .....4½ in.
Piston packing .....Gun iron ring
Smoke stack, diameter .....18 in.
Top above rail .....16 ft.
Tender frame, Ry. Co.'s—
Center sills .....13 in.—55 lb. channel
Side sills .....10 in.—30 lb. channel
Tank, style.....U shape sloping side and back coal space
Capacity .....8,100 gallons
Fuel capacity .....14 tons
Valves, type .....Piston
Travel ..... 6 in.
Steam lap ..... 1 in.
Setting .....$\frac{3}{16}$ lead, not less than 85% cutoff
Wheels—
Driving, diameter, outside tire.....69 in.
Centers, diameter ..... 62 in.
Driving, material, main and others.....Cast steel
Engine truck, diameter..... 33 in.
Kind .....Spoke
Trailing truck, diameter ..... 42 in.
Kind .....Spoke center
Tender truck, diameter ..... 33 in.
Kind .....Midvale Steel Co.

VACUUM AUTOMATIC BRAKE IN INDIA, 1911.*

It is over a quarter of a century ago since the memorable "Battle of the Brakes" in 1885 on the frontier section of the North-Western State Railway (India). The experiments were carried out in the presence of the representatives of the competing companies, the Vacuum Brake Co., 32 Queen Victoria Street, London, E. C., and the Westinghouse Air Brake Company under the superintendence of the late F. B. Hebbert, chief engineer, State Railways. The vacuum automatic brake was accepted by the Government as best suited to the conditions of Indian Railway service and was adopted as the standard for that country. The provision of an effective automatic brake for the proper control of trains has been recognized as one of the first principles of securing safety, both in America and Great Britain.

During the year 1911 the vacuum automatic brake was fitted to 435 more locomotives, 1,131 passenger cars and 8,002 freight cars, making the totals on the 31st December, 1911, of braked locomotive and vehicle stock, as follows:—

	Fitted.	Not fitted.
Locomotives	5,713	1,702
Passenger cars	17,462	3,944
Freight cars	56,721	94,608

The above figures speak for themselves as to what has been done and still remains to be done. Locomotives are classified under three heads, and the following table shows the numbers:—

	Fitted.	Not fitted.	Pctge. fitted.
Engines used in passenger service	1,522	8	99.48
Engines used in freight service	1,521	216	87.56
Engines used on mixed trains	2,670	1,478	64.37

It will thus be seen that practically all the engines employed exclusively for passenger train service were fitted; and a large proportion of those used only for freight trains were also fitted with the vacuum brake.

The table below exhibits the total number of passenger and freight vehicles braked and piped:—

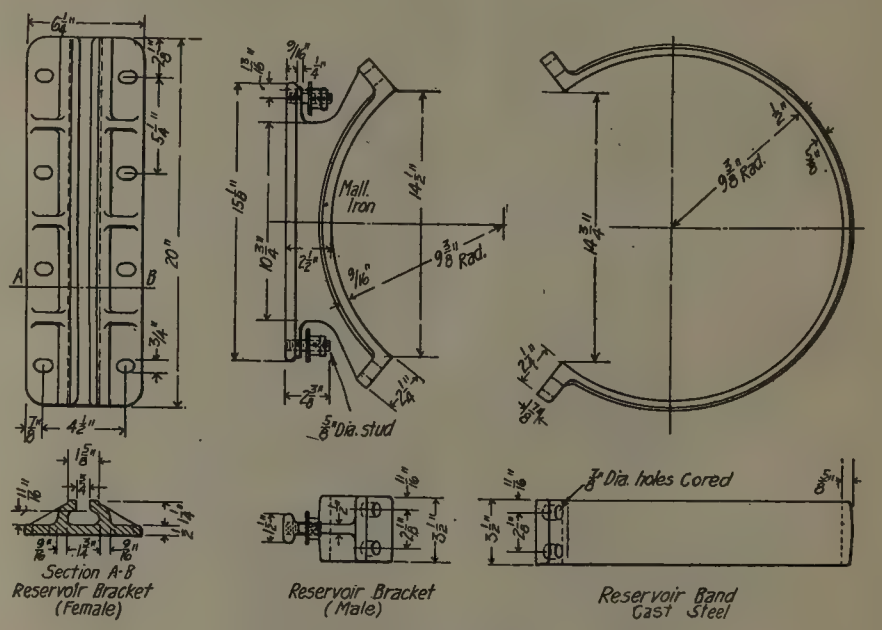
	Passenger Stock	Freight Stock
Braked Vehicles	16,107	47,302
Piped Vehicles	1,355	9,419
Not fitted Vehicles	3,944	94,608
Percentage (braked)	81.58	37.48

*From Indian Engineering,

RESERVOIR HANGER.

The accompanying drawing illustrates a device designed by Geo. J. Hatz, master mechanic of the Union Pacific, Omaha shops.

The hanger is arranged so that the air reservoir can be quickly and easily swung away from the boiler in order to



Locomotive Air Reservoir Support.

make repairs. In the case of the ordinary design it is necessary to take out a number of bolts and entirely disconnect the reservoir fastenings to make even minor repairs on the parts near it.

From the drawing it will be noted that by loosening only two clamping bolts, one section of the hanger may be slipped out of the other. A "Tee" slot in the boiler section permits of this freedom of motion. Considering the weight of a large reservoir it is a difficult task to take it completely down and by avoiding the necessity of this work, considerable time and effort is saved.

Personals

W. H. Williams has been appointed master mechanic of the Buffalo and Rochester division of the Buffalo, Rochester & Pittsburgh, at East Salamanca, N. Y., vice P. C. Zang, resigned. E. V. Brennan succeeds Mr. Williams as master mechanic of the Du Bois, Pa., shop. J. P. Kendrick has been appointed master mechanic of the Middle and Pittsburgh divisions with headquarters at Punxsutawney, Pa.

G. I. Evans has been appointed superintendent of locomotive shop of the Canadian Pacific with office at Montreal, Que. Mr. Evans was born at Montreal in May, 1880, and his entire railroad career has been with the Canadian Pacific, where he has received rapid promotion. He began as a draftsman in April, 1900, and was promoted to chief draftsman in March, 1906. In July, 1910, he was made mechanical engineer and remained in this position until he received his present appointment.

E. B. Rockwood succeeds B. C. Denmark as storekeeper of the Boston & Albany at West Springfield, Mass.

A. Maynes has been appointed master mechanic of the Canadian Pacific with office at London, Ont., succeeding A. E. Stewart.

E. A. Revele is acting master mechanic of the Chester-Perryville & St. Genevieve, at Cape Girardeau, Mo.

F. B. Kester succeeds F. R. Nelson as general foreman of the Chicago & North-Western at Kaukana, Wis.

E. J. Hufford has been appointed master mechanic of the Chicago Great Western at Des Moines, Ia. He succeeds F. L. Carson.

Rufus Penington, who was formerly vice-president and superintendent of motive power of the Marianna & Blountstown, has been made president and superintendent of motive power. His office is at Blountstown, Fla. We believe that Mr. Penington is the only mechanical department head who can also boast of being president of his road.

The title of H. F. Greenfield, formerly general foreman locomotive department of the Norfolk & Western at Roanoke, Va., has been made superintendent of shops.

C. E. Langston succeeds F. A. Walsh as master mechanic of the Marshall & East Texas. His office is at Marshall, Tex.

A. M. Darlow has been appointed superintendent of motive power of the Buffalo & Susquehanna with office at Galeton, Pa. He was formerly mechanical engineer and storekeeper. Mr. Darlow served an apprenticeship on the Vandalia and later graduated from Cornell University with the class of 1906. After graduation he became a special apprentice and later shop draughtsman of the Chicago & Eastern Illinois. In 1909 he was made roundhouse foreman of this road at Dolton, Ill., in 1910 held this position at Chicago and in 1911 was at Danville, Ill., in a similar capacity. In May, 1911, he was made mechanical engineer of the Buffalo & Susquehanna and in April, 1912, was also made general storekeeper, which position he held until his recent appointment.

F. C. Pickard has been appointed master mechanic of the Buffalo division of the Delaware, Lackawanna & Western with office at Buffalo, N. Y., succeeding F. G. Colwell, resigned. Mr. Pickard was formerly master mechanic of the Pere Marquette at Saginaw, Mich.

A. M. McGill has been appointed assistant superintendent of motive power of the Lehigh Valley with office at South Bethlehem, Pa. J. C. Seeger succeeds Mr. McGill as shop superintendent at Sayre, Pa.

W. H. Winterrowd has been appointed mechanical engineer of the Canadian Pacific with headquarters at Montreal, Que. He succeeds G. I. Evans, promoted.

Changes have been made in titles in the mechanical department of the Chesapeake & Ohio. J. R. Gould is now superintendent of motive power instead of general superintendent of motive power and title of C. H. Terrell has been changed to assistant superintendent of motive power with office at Richmond, Va. W. P. Hobson has been appointed master mechanic at Covington, Ky., and H. M. Brown has been appointed shop superintendent at Huntington, W. Va.

J. C. Shreeve has been appointed master mechanic of the Elgin, Joliet & Eastern with office at Joliet, Ill. He will have jurisdiction over the Joliet shops and points north.

S. J. Dillon has been appointed master mechanic of the West Jersey & Seashore with office at Camden, N. J.

Stanley S. Wagar has been appointed chemist and engineer of tests of the Buffalo, Rochester & Pittsburgh with office at Du Bois, Pa.

W. L. Wene has resigned as purchasing agent of the Tennessee Central and his duties will be assumed by the president, A. B. Newell, of Nashville, Tenn.

F. G. Grinshaw has been appointed assistant engineer of motive power of the Western Pennsylvania division of the Pennsylvania, with office at Pittsburgh, Pa.

M. F. McCarra has been appointed master mechanic of the Louisiana Ry. and Navigation Co., with office at Shreveport, La., succeeding T. Nicholson.

J. S. Golithon succeeds J. A. Haley as master mechanic of the Bellingham Bay & British Columbia with office at Bellingham, Wash.

Charles Ware has been appointed general manager of the Union Pacific with office at Omaha, Neb., succeeding W. B. Scott.

W. A. Garrett has been appointed vice-president of the Chicago Great Western in charge of operation and assumes the duties of H. J. Slifer, general manager, who has resigned. Mr. Garrett's headquarters are at Chicago.

M. A. Ramsey has been appointed superintendent of the Central of Georgia, at Macon, Ga., vice, E. H. Daniel, transferred. Henry Baldwin succeeds Mr. Ramsey as superintendent at Columbus, Ga.

J. E. O'Hearne has been appointed superintendent of motive power of the Chicago & Alton, with office at Bloomington, Ill., succeeding J. T. McGrath, resigned. Mr. O'Hearne was formerly master mechanic of the Wheeling & Lake Erie at Brewster, O.

G. H. Bussing, superintendent of motive power of the New Orleans Great Northern, has resigned and the position has been abolished.

H. J. Osborne has been appointed master mechanic of the Chicago, Rock Island & Pacific with headquarters at Eldorado, Ark. He succeeds W. F. Moran.

Among The Manufacturers

DRIVING BOXES AND WEDGES.

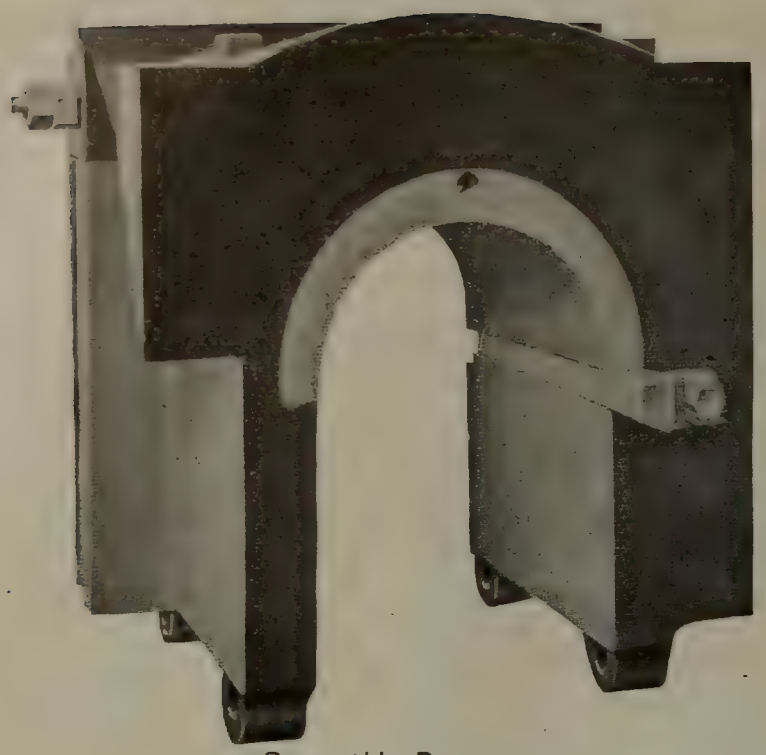
By L. W. Barker.

Driving boxes are the pillar block of locomotive construction and since locomotives were first built, there has been no change in driving box and wedge construction until very recently. The roads and builders have been very slow in adopting any change, probably for the reason that a large majority of the superintendents of motive power and a good many builders served their day in the shop and know how much pains was taken in the fitting up of the driving box and the pressing in of the brass and even under the most careful fitting they would get loose and work in and out and pound, and the wheels have to be dropped to renew the brass. Of course with visions of these experiences and knowing full well the importance of driving boxwork they have hesitated to adopt any changes.

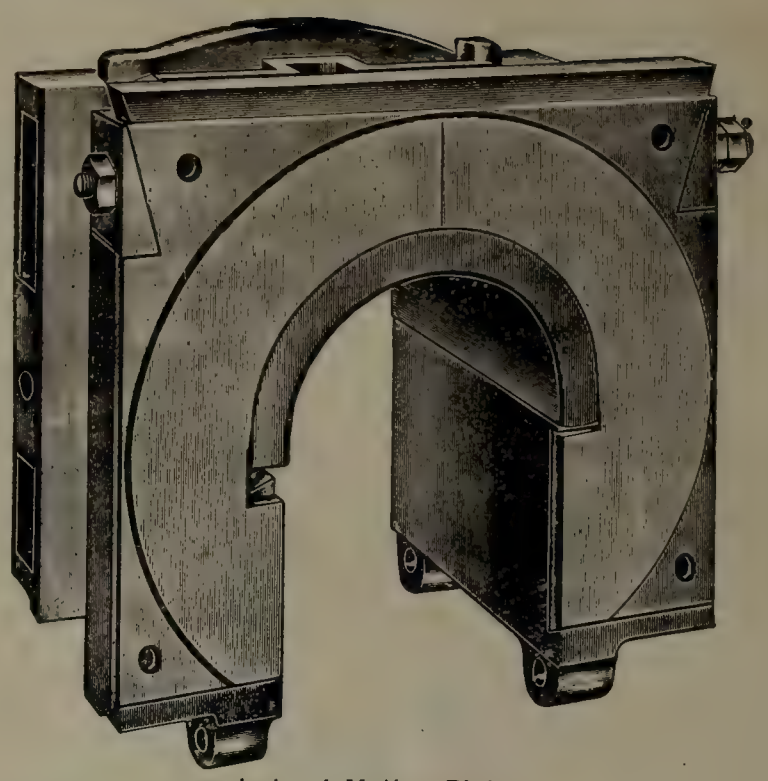
There is now on the market a removable brass which seems to have proven very superior to the old construction.

This brass is made on jigs at a very small labor cost and kept in stock. The jigs are made from scrap material and are inexpensive to make, and three sizes of keys and three sizes of brass jigs are adopted to any size or class of power.

In changing the brass all that is necessary to do is to lift the



Removable Brass.



Lateral Motion Plates.

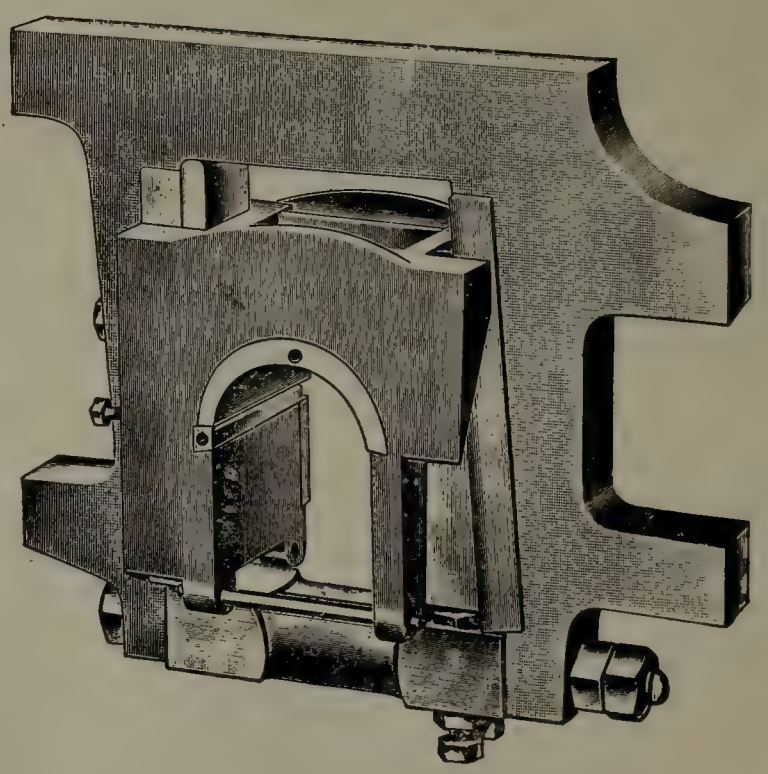
weight of the box from the journal, pull the key and either refit the old brass, if it is large for the journal, or get a new one from the store-room and make the journal fit and replace and drive the key. In either case the work is done in three hours. When the key is driven 1½ inches the brass has 20 tons pressure on it and every box has the same, the brasses being expanded to a better fit in the box than can be obtained by pressing them in, and they run longer. Compare this method of fitting and renewing driving box brasses to dropping wheels, the slow expensive process of making a brass to fit every slot in every driving box, laying an engine up two or three days to do the work.

Lateral or hub motion is another source of expense that has been a large item, more with some roads than others, but serious with all. There is now on the market and being used in large numbers a lateral motion plate as shown in the illustration.

These plates are dovetailed top and bottom and held in place by a bolt running through back of the plates with a bevel washer on either side. The plates are interchangeable, kept in stock, babbeted and can be changed in 30 minutes. A very large saving compared with dropping wheels and holding engines in for lateral motion.

Another device which is coming into use very rapidly is a wedge without any flanges. It will be noticed by the illustration that there are steel plates riveted on the sides of the jaw the thickness of the original flange on the wedge. This entirely does away with broken flanges on wedges, makes an easy wedge to set up and, by removing a part of the back inside flange of the driving box, the wedge is lined down by simply taking out the wedge bolts and removing the wedge sidewise instead of taking down the pedestal binder.

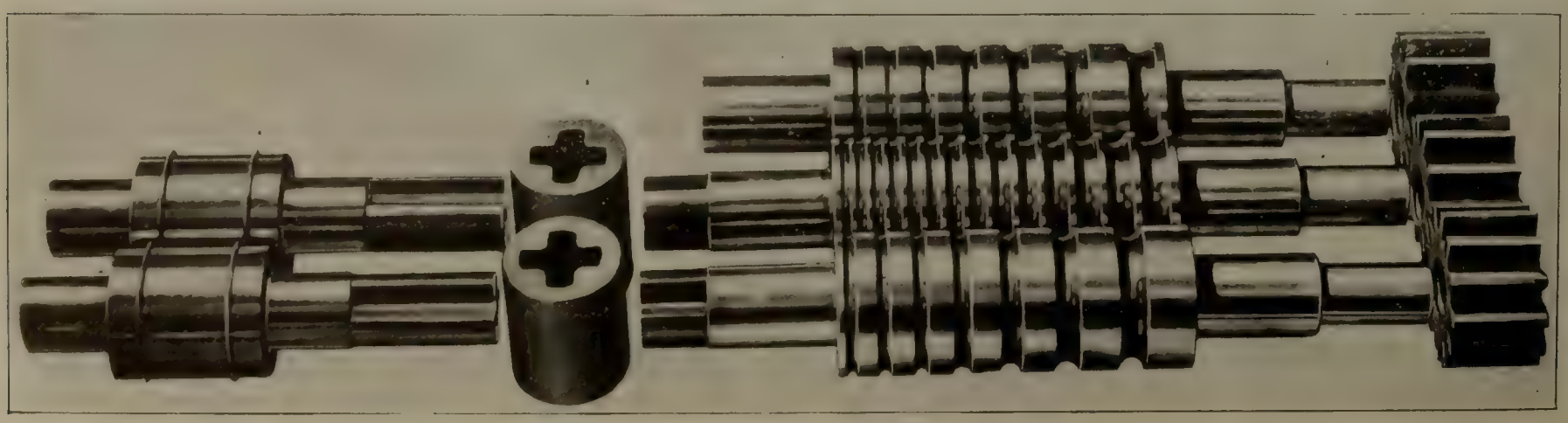
H. T. Bentley, assistant superintendent motive power and machinery of the Chicago & North-Western Ry., recently included in an address before the Master Mechanics' Convention, a statement in detail of their advantages and savings. These devices have been made the standard construction of all driving boxes and wedges of the Chicago & North-Western.



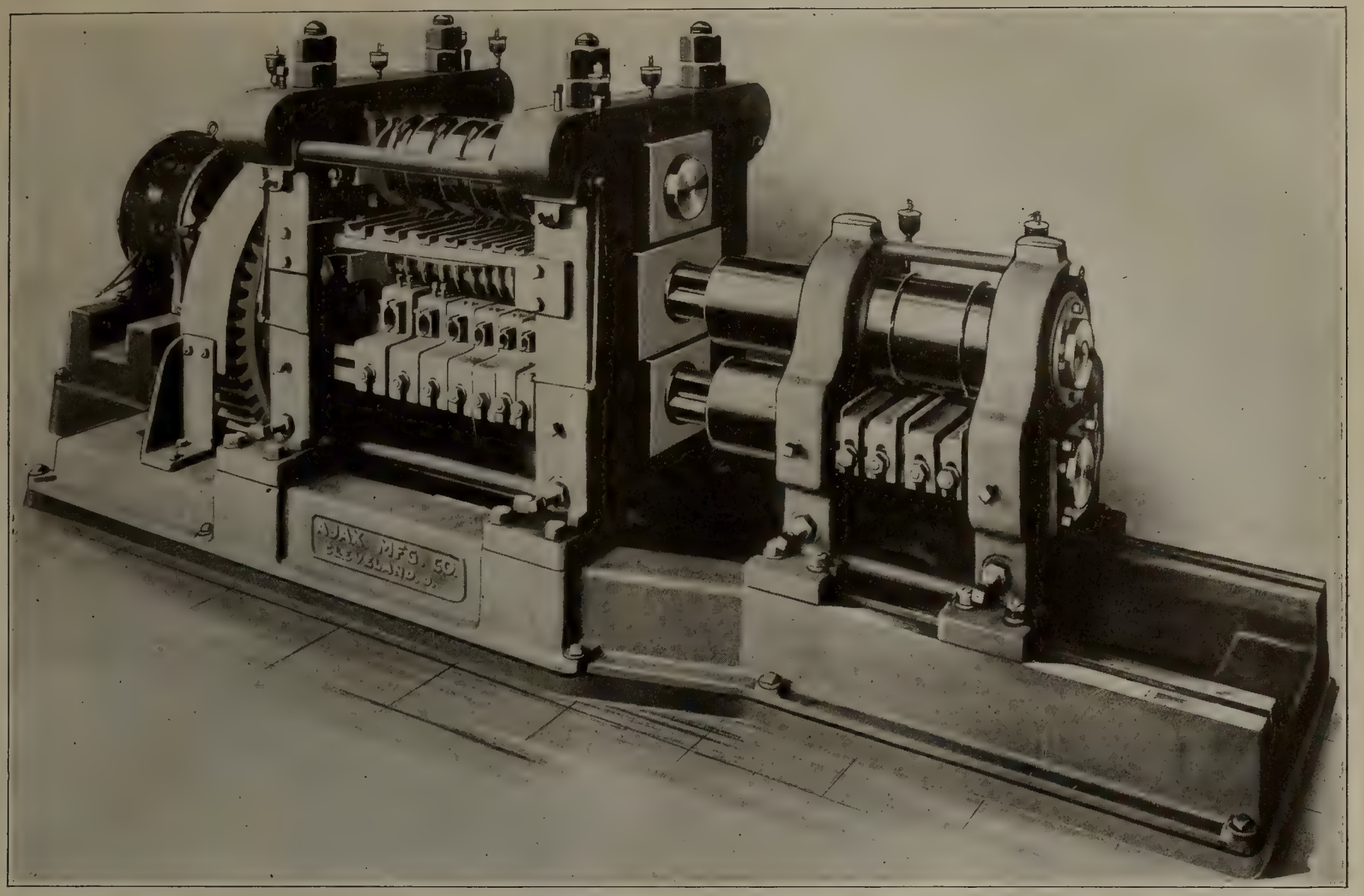
Flangeless Shoes and Wedge

Quite a number of other roads are taking them up. The savings show not only in the time engines can be kept out of the shop but the avoidance of laying engines up for driving box or wedge work make these devices of extreme importance to the railroads. They are applied to old boxes as well as new.

These devices are handled by The Locomotive Improvement Company of Clinton, Iowa.



Ajax Main and Reducing Rolls.



Ajax Reclaiming Roll Mill.

AJAX RECLAIMING ROLLS.

The reclamation of railway scrap iron and steel by heating the bars and re-rolling them to a smaller size as accomplished by the Ajax reclaiming rolls is a process of interest owing to the enormous amount of scrap truss rods, arch bars, draw bars, center pins, etc., which have heretofore been sold at scrap prices, and which can now be re-rolled into round stock from which bolts can be made, and flat bars from which various car fittings can likewise be made.

The reclaiming of such bars has passed beyond the experimental stage and is now being successfully performed in the shops of a number of the railway systems. The Ajax Manufacturing Company, of Cleveland, Ohio, having developed, after several years' of experimenting, a successful reclaiming roll machine.

The machine is of the three roll high type, as illustrated herewith and is provided with an auxiliary or secondary set of rolls for splitting flat stock longitudinally, preparatory to re-rolling it in the main reducing rolls.

These rolls are made in several sizes, the standard machine having a capacity for re-rolling 2-in. rounds down to and including ½-in. or corresponding sections of flats or squares.

The scrap bars are ordinarily cut into lengths varying from two to five feet long depending upon the section; the larger the bar; the shorter the length to which it is cut. These are heated in suitable furnaces and are started thru the rolls: first pass reducing the bar to an eliptical shape, and on the return pass it is reduced to a round. This process is repeated until the stock is reduced to the size desired.

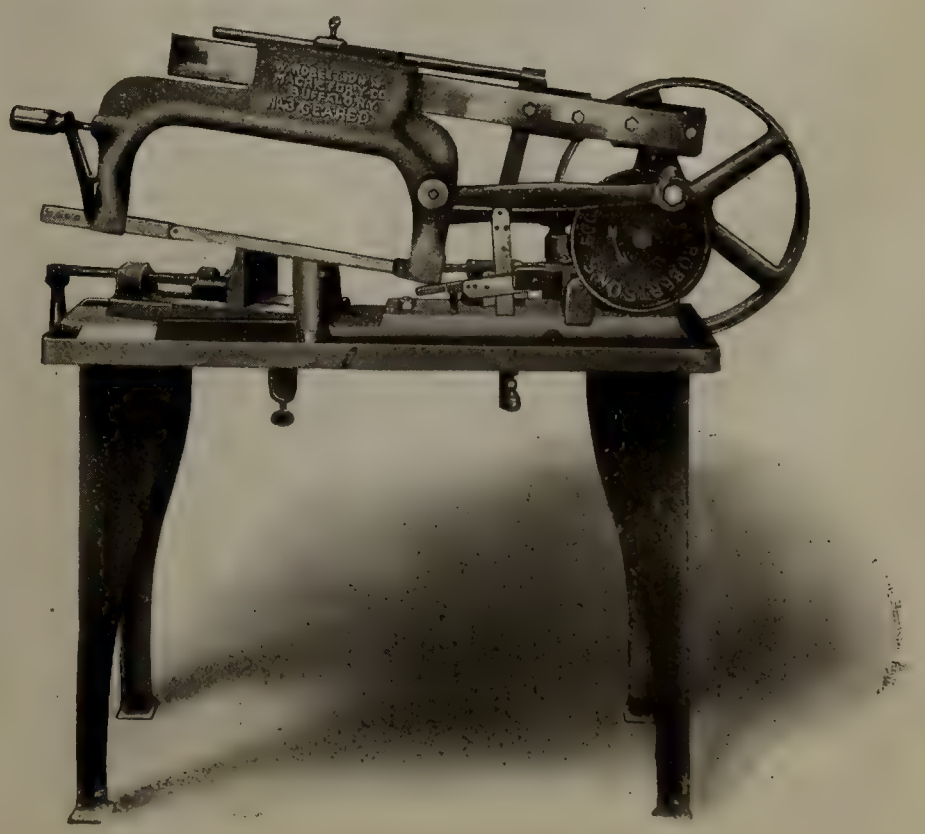
The average production ranges from six to eight tons per ten hours, the fuel cost averaging about $6.00; the operating crew consisting of four to five men—one roller, an assistant roller, a heater, a helper, and a man to carry the re-rolled bars off to cooling and straightening tables.

The machine as built has full adjustments and rolls are turned from forged steel of special analysis and are carried in phosphur bronze bushed bearings. The full adjustment permits re-grooving of the roll.

A complete set of in and out guides are furnished to the main reducing rolls, and also to the splitting roll, thus making the operation of handling or feeding the stock into the rolls same as in regular roll mill practice.

"ECONOMY" POWER SAW.

The machine shown in the illustration is the Economy Power Saw No. 2 manufacturered by the W. Robertson Machine &



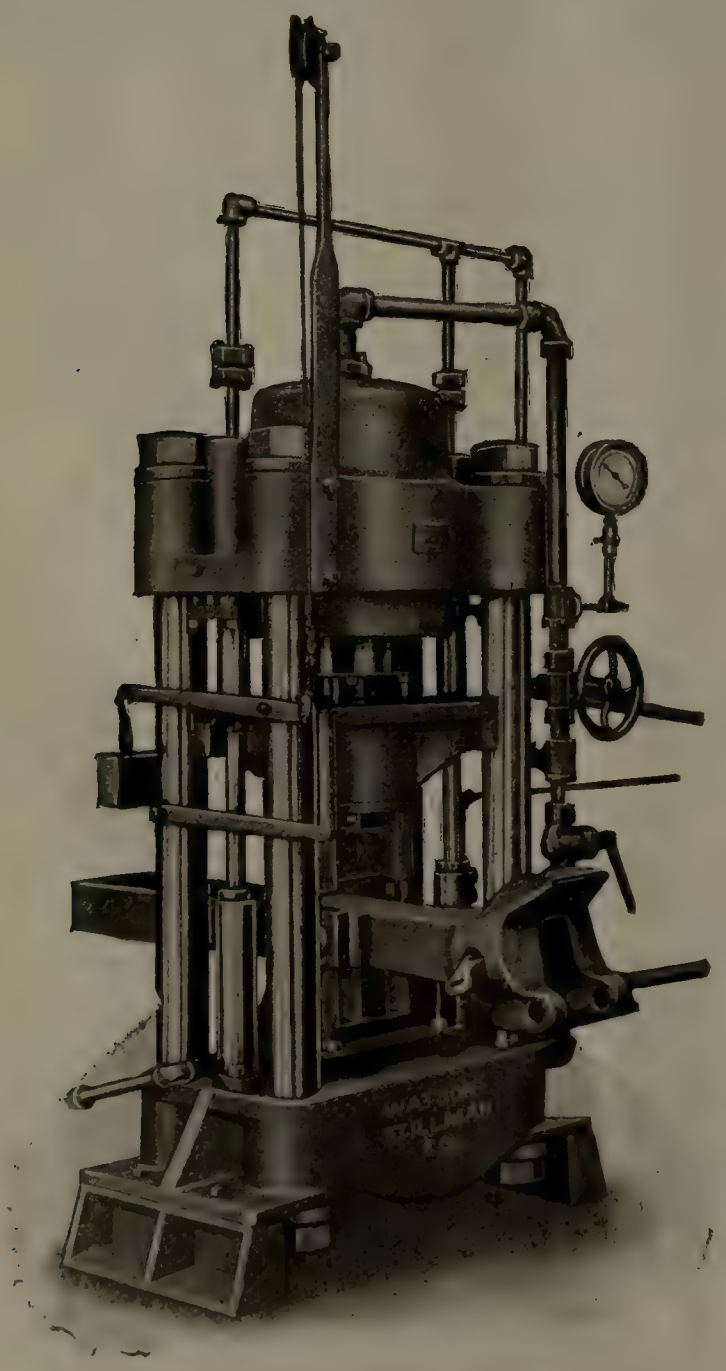
"Economy" Power Saw.

Foundry Co., Buffalo, N. Y., and is very popular in many shops all over the country. These tools operate on the draw stroke and release on the return or idle stroke through the action of an eccentric cam located on the crank shaft. With this arrangement the blade is let down to work just as the crank passes the center and starts to raise it just as the stroke is completed, thus a blade will out-wear and do several times the amount of cutting over the ordinary type of power hack saw machines.

The Economy saw is also provided with means for using short blades. As will be noted in the illustration, the frame is mounted on a flat steel bar, which is supported in dead center of the frame and central with the blade, insuring straight cutting under all circumstances. The vise is a very heavy and well made part. It swivels to 45 deg. angle and is graduated and is provided with the clamping bolts. The head is secured to the bed by bolts and is milled to fit closely in grooves, insuring alignment at all times. A quick acting clutch with automatic stop when the cut is completed, is also a part of the equipment. The machine weighs 250 pounds net and is one of the six sizes made by the above company.

CAR COUPLER SHEARING AND RIVETING MACHINE.

A new hydraulic coupler yoke shearing and riveting press, designed and built by the Watson-Stillman Co., 50 Church St., N. Y., is said by its manufacturers to shear riveted coupler yokes from their couplers, or clamp and rivet the couplers and yokes together as fast as brought to and from the press. Either operation is effected at a single stroke of the ram, and the use of hydraulic power further tends to



Shearing Yoke Rivets in a Press.

Riveting Yokes in Press.

effect economy and labor saving over the common practice of doing this work by hand and pneumatic hammer. The man operating the press can spend much of his time helping to handle the couplers and yokes.

This press will handle standard coupler shanks and yokes up to 5 in. by 7 in., and rivets up to 1¼ inches in diameter. The action is shown in the accompanying illustrations.

The press is built with heavily-ribbed platens with plenty of room for placing and removing the work, two push-back rams for quickly and automatically returning the large ram, and gauge and valves in full view and easy control of the operator. The capacity of the press is 200 tons. It weighs complete. 7,858 pounds.

One of the illustrations shows the press in the act of shearing the coupler from its yoke. The yoke rests upon supporting blocks which the coupler shank clears. The ram descends upon the coupler shank, forcing it downward and shearing both ends of the rivets in one ram movement, the yoke being left upon the blocks.

The other illustration shows the coupler with yoke and rivets attached and everything in readiness for heading the rivets. The main ram and clamping rams start downward simultaneously, the small rams first clamping the yoke to the coupler shank. The riveting die attached to the large ram then descends upon the rivets and heads them.

CAR SEATS.

The Walker & Bennett Manufacturing Company, 30 Church street, New York, has recently developed many new ideas in

Walker & Bennett Car Seat.

car seats, and has at present four distinct types of car seats of different mechanism, each type having several patented features in the detail of its construction.

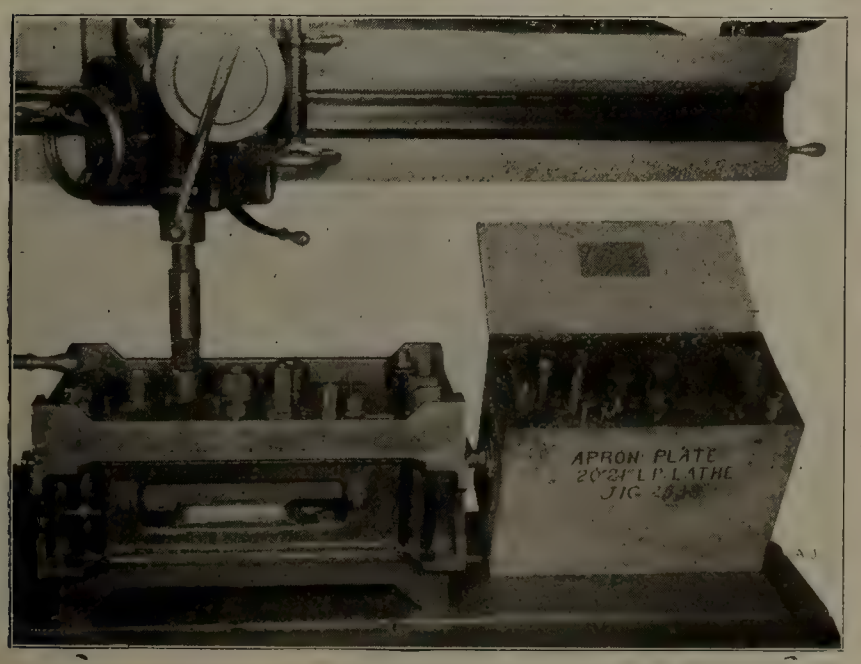
The development has been in the nature of replacing cast-iron parts with pressed steel; also in the reducing of the number of working parts, making a simple seat, hence the trade name "Simplified Car Seats."

A correct imitation in finish of mahogany and oak arm-rests is produced in steel, giving a very pleasing effect. With the many different combinations that can be made with the four distinct types of mechanism, all conditions that arise in the seating of wood or metal cars for both steam and electric railroads, can be met, and the strongest, lightest, and simplest seating furnished.

RADIAL DRILL AS A BORING MACHINE.

With the probable exception of the engine lathe, no machine tool has been improved in recent years as greatly as the radial drill. This type of machine has been improved and developed until now it not only serves the purpose of a radial drilling and tapping machine, but also does service as a boring machine as well. In fact, on some classes of boring, the radial drill has proven itself to be far superior in every respect to the horizontal boring machine.

The American Tool Works Company of Cincinnati has in its



Jig and Tools for Drilling Apron Plate on a Radial Drill.

works a large number of horizontal boring mills of the very best makes, and therefore, has had ample opportunity to judge of the boring qualities of the radial drill in comparison with the horizontal boring machine.

For example, the quick change gear boxes of 16 in. "American" high duty lathes were formerly bored on the latter type of machine, the time consumed in this operation being 216 hours for 36 pieces. These parts are now bored on a 6 ft. "American" radial drill by means of a suitable jig the time being reduced to 45 hours for a lot of 36 pieces, thus effecting a saving of 171 hours on this one job alone.

As a further example, the aprons on "American" 24 in. high duty lathes were formerly bored on a horizontal boring machine in lots of 12, each lot requiring 72 hours. This same apron is now bored on a 6 ft. "American" radial drill by means of a jig, as shown in the illustration, the actual time consumption being 24 hours. It will be evident from this that a saving of 48 hours has been accomplished on this operation, or an actual time saving of 66 2/3 per cent.

Likewise, there are many jobs that can be much more advantageously handled on a radial drill than on a horizontal boring machine, and it would therefore, certainly pay every manufacturer who has any boring to do, to investigate this subject. This is not meant to discredit the advantages claimed for the horizontal boring machine as there are numerous jobs that can only be satisfactorily handled on a machine of this type.

ACME SECTIONAL DIAPHRAGM.

The Acme sectional diaphragm is a two-fold, two-pleat diaphragm made of heavy three-ply cotton belting in three sections: one at the bottom of each leg and the third made up of the arch and upper parts of the legs. It is bound together with a continuous brass binding around the outside fold. This not only makes a positive and lasting binding, but supports the arch and prevents sagging. The construction is such that there are no sharp valleys. This is accomplished by using two pleats instead of four to make the two folds, which makes the valleys "U" shape instead of "V" shape as in most diaphragms. In other words, each pleat is one piece instead of two pieces as is usually the case.

The arch due to the character of its design is very strong and so constructed that is naturally sheds all water. This prevents any soaking of moisture of water through to the inside of the belting and the diaphragm itself. It has a double thickness at the arch, which also provides additional protection.

Instead of using a supplemental hood the Acme sectional diaphragm is provided with a double thickness at the top. This top piece is made of fire and water-proof material and protects the diaphragm proper. This feature does away with supplemental hoods and makes a self-cleaning top.

The boot is 24 inches high and is found at the bottom of each leg and extends 4 inches above the bottom of the leg portion of the diaphragm proper. It is placed inside the leg so as to provide lap and drainage and is made from a piece of 24-inch three-ply cotton belting. This boot has the warp of the belting running at right angles to the length of the diaphragm leg, which adds greatly to its strength. It is not rigidly connected to the leg proper, and does not have a tendency to draw up from the buffer plate at the inner folds when the diaphragm expands, and consequently, always hugs the buffer plates securely. This is not possible with any other diaphragm.

While the two pleats are sewed together, it is with only one row of stitching; the real binding of two pleats together is accomplished by a deep brass channel capped over the edges of the belting. This channel has the legs rounded out over the extremities so as to prevent any possible cutting of the belting at this point. This brass binding is securely fastened by large brass staples passing through one leg of the channel, thence through two pleats and the other leg of the channel, where the ends of the staples are bent over and thus securely anchored.

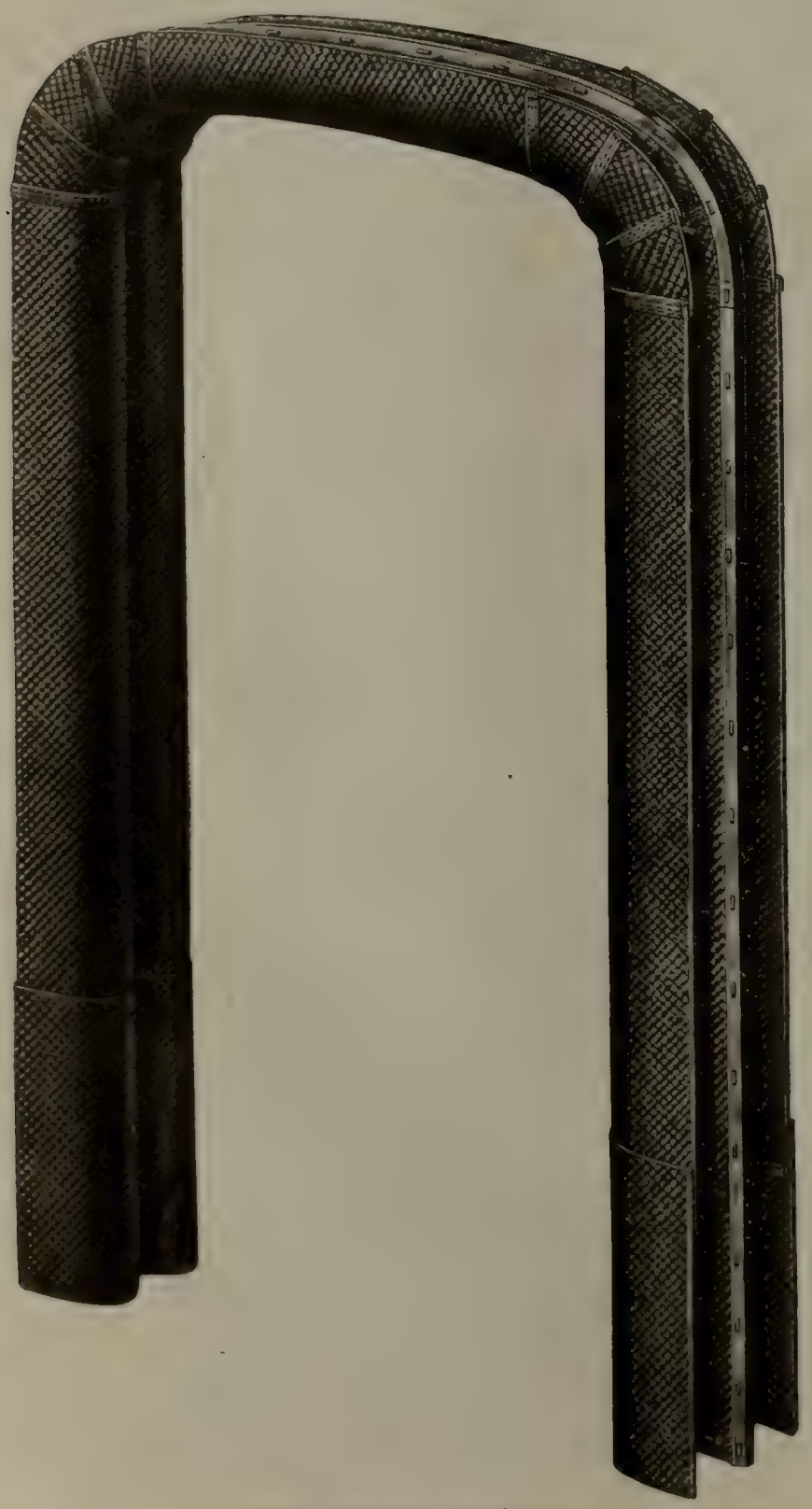
These staples are located 6 inches between centers. The channel is made in three sections, one for the arch and one each for the two legs, and is made of brass to avoid any possibility of corrosion.

All raw edges are reduced to the minimum and are found only at the bottom of the legs and at the haunches of the arch. They are fully protected by Fabrikoid water-proof binding thoroughly sewed to the belting.

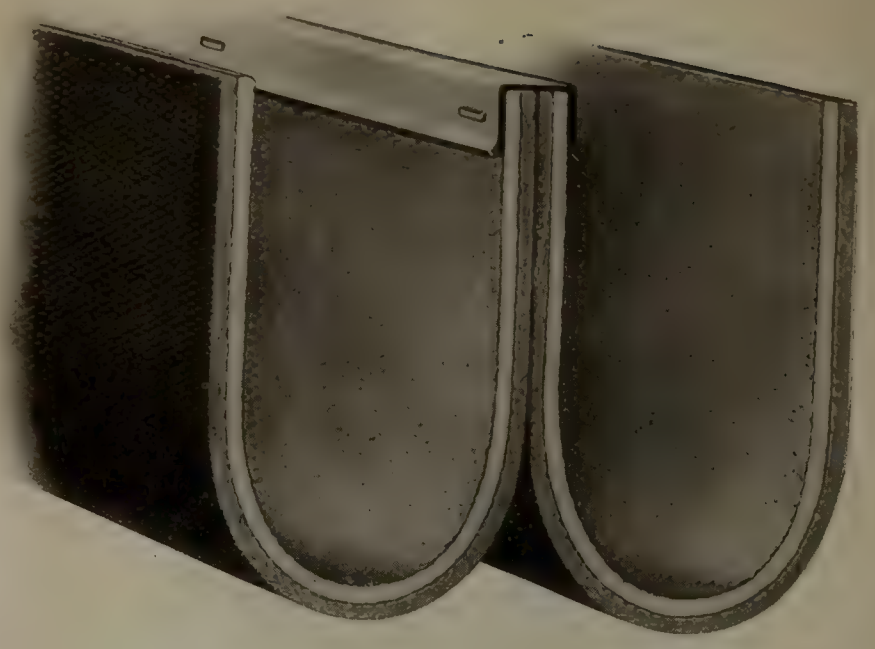
This diaphragm is made up of two folds, as shown, and provides an expansion of 20 inches, which is ample for all requirements. It can be furnished in cotton belting, dyed fast black, although it is recommended that it be furnished fire and water-proof. This can be obtained with the cotton belting treated on one side only or on both sides. Best results will be obtained with belting treated on both sides, which materially strengthens the belting and acts as a prevention against moisture and its bad effects.

Since it is put together by means of brass binding and staples, all that is necessary in making repairs is to remove the staples, and insert a new piece. This can be done at any point. The bottom piece or boot can be very easily renewed, and as it is placed at the point where repairs are usually necessary, they can be accomplished with least possible labor and delay.

The Acme diaphragm can be made in the ordinary Pullman face type shape or with the Apex shape, which provides a sharp



Acme Sectional Diaphragm.



Acme Sectional Diaphragm.

drain for the top, and is used where only one buffer spring is used instead of the two, as is usually the case.

In using this diaphragm, the supplemental hood is entirely done away with, there is no weakening of the diaphragm by stitching of the binding and, because the top of the diaphragm is always in plain sight, it not only can be more easily inspected, but, being in the clear, the motion of the train has a certain suction tendency to clean it.

New Literature

The Chicago Pneumatic Tool Co., of Chicago, has issued booklet number 119 on the operation and upkeep of "Rockford" railway motor cars. It is of convenient size for ready reference and covers the subject in hand thoroughly. The same firm has issued bulletin 120 containing instructions for operating Chicago Giant rock drills.

* * *

The Vulcan Engineering Sales Co., of Chicago, has published a number of leaflets covering its various products. Among these are Mumford jolt ramming machines, and core bench jolt rammers, QMS pneumatic hoists, jib cranes and hand power traveling cranes.

* * *

Leaflet 2444 issued by the Westinghouse Electric & Mfg. Co., of Pittsburgh, Pa., covers the equalizer flywheel hoisting sets used in conjunction with electric hoists. Application views together with the diagram of connections showing the liquid rheostat are also given. The leaflet also describes the system in which these devices are used.

Bulletin 4017, describes a new line of "Butterfly" hand hammer drills manufactured by the Ingersoll-Rand Co., New York City. These drills are adapted for such work as pop shooting, breaking up boulders, trimming walls, and all work requiring holes not exceeding five feet in depth. Catalog illustrates the various types and sizes as built and a sectional view on the last page shows the duplicate parts."

* * *

The United States Engineering Co., of New York, N. Y., is sending out a booklet descriptive of the briquetting machinery manufactured by Wm. Johnson & Sons, of Leeds, England. This machinery is adapted for briquetting of coal, ore and coke, in all sizes and the U. S. Engineering Co. is vigorously pushing its sale in this country.

* * *

The Baldwin Locomotive Works, of Philadelphia, Pa., has issued "Record No. 72" dealing with the subject of Mallet articulated locomotives. It contains much valuable reading

matter and a number of excellent illustrations showing the piping arrangements under different conditions.

* * *

"Hydraulic Accumulators," is the title of Catalog No. 84 just issued by the Watson-Stillman Co., of New York, and illustrating, tabulating and fully explaining the seven principal types of accumulators which it manufactures. A few pages are devoted also to accumulator accessories and to special hydraulic testing apparatus and reservoirs.

* * *

The National Tube Co., of Pittsburgh, Pa., has published a very attractive booklet on "Modern Welded Pipe," illustrating and describing the progressive operations from ore to finished products. It is an interesting booklet from start to finish and is also a handsome example of the printer's art. Of particular interest to the mechanical and shop man is the section relative to pipe threading dies and the section on corrosion of pipes and tubes.

* * *

A brief description and illustrations of the plant and product of the Mesta Machine Co., of Pittsburgh, is given in a booklet recently issued by this firm.

* * *

The Industrial Works of Bay City, Mich., has recently issued a beautifully illustrated pamphlet describing the work of forty-two of its locomotive cranes which were purchased by the United States Steel Corporation and used in the construction of the large steel manufacturing plants at Gary, Ind., and at South Chicago, Ill. It is stated that this is the largest individual order for locomotive cranes ever placed. The photographic reproductions show the use of the cranes from the breaking of the ground to the completion of the buildings and the handling of the products. The Industrial Works manufactures, besides locomotive cranes, pile drivers, steam hammers, transfer tables, rail sawing machinery, drag line excavators, grab buckets and lifting magnets, cranes for railway wrecking purposes being one of the most important classes of lifting machines which this concern builds.

Industrial Notes

The fifth annual convention of the Association of Railway Electrical Engineers will be held in the Auditorium Hotel, Chicago, October 21-25. The electrical men of all the big railroads of the United States and Canada will here be gathered together for a conference on standardization of electrical practice on steam railroads, and many valuable papers and committee reports are planned. The hall occupying the 9th floor of the Auditorium Hotel has been reserved for convention exhibits, and judging from previous years, this space will all be taken by prominent manufacturers of electrical equipment. As in previous years, an entertainment program will be provided which will include an informal dance, automobile tour of Chicago parks, and a theatre party, closing with the annual banquet.

The Case Crane & Engineering Co., Columbus, Ohio, has been incorporated and has taken over the plant and business of the old Case Crane Company, of Columbus. Paul T. Norton, who has been associated with the Jeffery Manufacturing Company, has been made president and general manager of the new company.

Richard J. Sheridan, formerly assistant to H. A. Fabian, manager of purchases and supplies of the New York, New Haven & Hartford, with office in Boston, Mass., has been made eastern agent of the Chicago Railway Equipment Co., succeeding C. P. Williams.

Charles E. Lee, general superintendent of the Boston & Maine, with office in Boston, Mass., has resigned to go to the Commercial Acetylene Co., New York, as general manager, with office in New York.

The Industrial Supply & Equipment Co. has appointed as Chicago agent John E. Chisholm, formerly superintendent of motive power of the Chicago Great Western. Mr. Chisholm's office is in the Old Colony building.

Charles P. Williams, who has been eastern agent for the Chicago Railway Equipment Co., with office in New York, has resigned to become connected with the National Lock Washer Co., Newark, N. J., with headquarters in the Chicago office. Mr. Williams has formerly been connected with the Chicago, Milwaukee & St. Paul, the Michigan Central, the Canadian Pacific, and the Minneapolis, St. Paul & Sault Ste. Marie.

The Concrete Foundation Co., of Kansas City, Mo., has started work on the foundation and approaches of the new Broadway viaduct at that place, which is to be the largest of 43 viaducts and subways being built by the Terminal Company. The remainder will be built by the American Bridge Co. The entire length of the viaduct will be 1,467 ft. The north approach will be 230 ft. long, and the south approach, now being built, is 92 ft. long. The other 1,145 ft. will be in spans of steel, carried on caissons set on bed rock. There will be a 54-ft. roadway and two 13-ft. sidewalks. The superstructure of the entire viaduct will be of concrete.

The Northern Pacific has awarded the contract for the construction of all the masonry work, arches and bridges on its right-of-way between Island Mountain tunnel and Fort Seward to Mercer-Frazer Co., San Francisco, Cal.

The Pennsylvania Lines have closed bids on a large freight house and sheds at Indianapolis, Ind. This road has also submitted plans to the city for a concrete and steel 20-stall roundhouse at this point.

E. J. Pearson, vice-president of the Missouri Pacific, has notified Little Rock, Ark., that the ordinance providing for the construction of the W. 13th St. viaduct has been accepted and that the work of construction will begin as soon as the steel can be obtained. According to the provisions of the ordinance, the Rock Island and Iron Mountain roads are required to construct a steel viaduct, with creosoted wood floor, over their tracks on W. 13th St., and the city of Little Rock and the Little Rock Railway & Electric Co. will keep and maintain the flooring utilized by each in good condition.

The Southern Railway has given a contract to H. F. Elliott, Hickory, N. C., for building a combination station, a cotton platform, and making track changes at Maplesville, Ala. The work will be started at once, and will be pushed to completion. The original plan of building a joint station with the Mobile & Ohio has been abandoned.

Plans have been prepared by the Bangor R. R. & Electric Company, in accordance with instructions of the State Board of Railroad Commissioners, for the construction of a bridge over the Stillwater River at Orono, Me. The tentative plans call for a two-span "camel-back" type structure 400 ft. long, with 20-ft. roadway and 6-ft. sidewalk.

Extensive passenger and freight terminals will be put up by the Baltimore & Ohio at Allegheny, Pa. Plans are now being made for the improvements to include a passenger station and office building, and a large freight house. The work will cost about $250,000. The passenger station is to be 100 ft. long x 38 ft. wide, of brick construction. The freight house will be two stories high, 352 ft. long x 100 ft. wide. Besides the passenger and freight buildings, there will be a viaduct 30 ft. wide running alongside of the freight building at the second-story level, leading from Anderson street to Sandusky street, for a distance of about 450 ft.

Recent Railway Mechanical Patents

CAR, HOSE, AND ELECTRIC-WIRE COUPLING.

1,039,147—Louis Le Compte and Joseph Le Compte, Aurora, Ill., assignors, by mesne assignments, to The Le Compte Company, Chicago, Ill.

This is a car coupling device which has the combination of a draw head, connecting mechanism adapted to connecting mechanism adapted to connect said draw head with an adjacent draw head, a coupler shoe movably mounted on the draw head and supported independently of said connecting mechanism and adapted to be moved transversely with respect to the draw head, and an electric wire supported by said coupler shoe and movable therewith into engagement with an adjacent electric conductor.

OXY-ACETYLENE-TORCH.

1,039,238—Prior F. Willis, St. Louis, Mo.

This is an oxy-acetylene torch a burner head comprising a body having a nozzle extension and a coupling extension or extensions, said body having intercommunicating passageways for oxygen and acetylene gas, respectively, said coupling extension or extensions having supply ducts for oxygen and acetylene gas communicating with the respective intercommunicating passageways, said nozzle extension having a passageway for mixed oxygen and acetylene gas extending therethrough and communicating with said intercommunicating passageways at their point of connection, said body and coupling and nozzle extensions being integral throughout said passageways and ducts.

EXHAUST-STAND.

1,039,524—Andrew Jackson Hall, Clinton, Ill.

This is an exhaust stand having a base having a pair of inlet ports separated by a diaphragm, said base further having a passage leading laterally through said diaphragm to the center thereof and extending upward therefrom, the upper end of said passage being threaded, a vertical draw pipe screwed into said base and provided with threads at its upper end, a frusto conical nozzle having a frusto conical interior located on said base, and a valve of double frusto-conical shape, said valve having its greatest diameter centrally, said valve being provided with a threaded opening and being screwed on to the upper end of the draw pipe whereby the height of the draw pipe may be varied and the position of the valve on the draw pipe be also varied independently one of the other.

UNDERFRAME FOR DUMPING-CARS.

1,039,638—William P. Bettendorf, Bettendorf, Iowa.

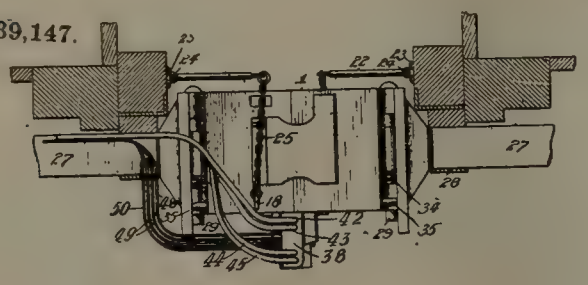
This is an underframe for cars comprising side-sills, center-sill, end-sills, integral bolsters extending from side-sill to side-sill having a depression in their upper central portions, and their undersides curved like a rocker, and a horizontally disposed channeled cradle in which said bolster is seated.

WHEEL-FLANGE LUBRICATOR.

1,039,650—Philip Conniff, Washington, D. C., assignor, by direct and mesne assignments, to The Collins Metallic Packing Company, Philadelphia, Pa.

This is a wheel-flange lubricator having the combination of a holder adapted to contain a solid bar of lubricant, said holder being open at its opposite ends, a detachable closure for the rear end of the holder, said closure having an opening therein, a follower within the holder for feeding the bar of lubricant through the open front end of the holder, a coiled spring for forcing the follower forward, said spring being arranged within the holder between said follower and closure and extending rearwardly through the spring and outwardly through the opening in the closure, a pull connection attached to the follower and movable through the opening in the closure, whereby the follower may be retracted and the spring collapsed and the two held nested against the closure for withdrawal therewith, and means adapted for coaction with said pull connection and closure to hold the follower and spring retracted and in fixed relation to the closure.

1,039,147.



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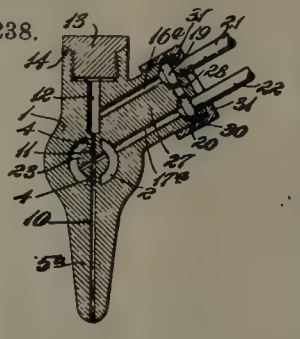

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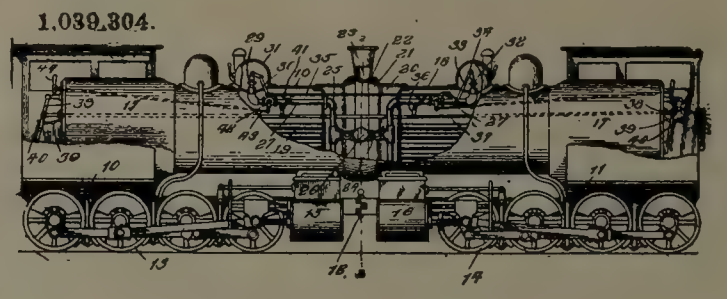

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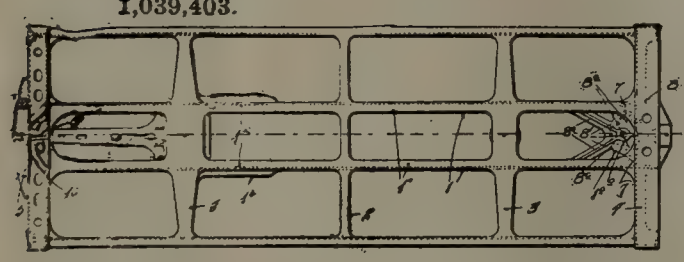

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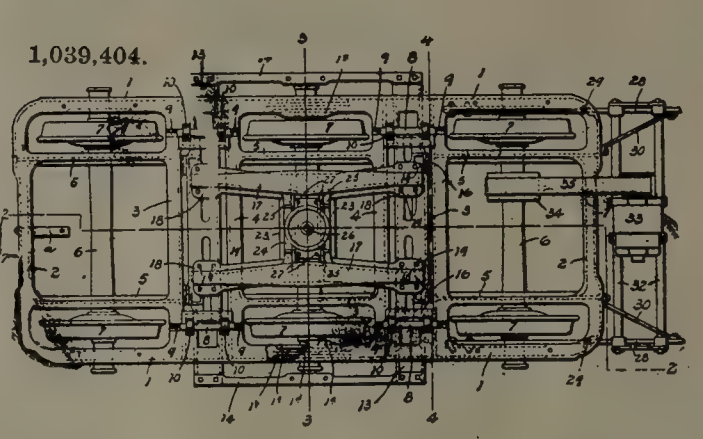

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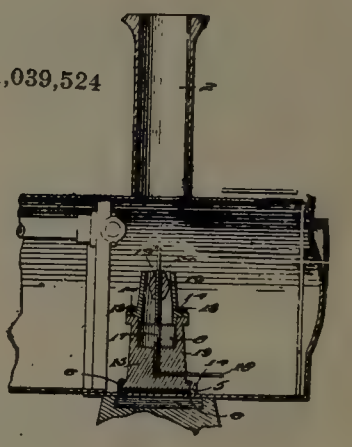


LOCOMOTIVE.

1,039,304—Frank Martin, Renova, Pa., assignor of one-half to Morris Di Bella, Renova, Pa.

This is a locomotive, consisting of opposing boilers each including a fire-box, a shell inclosing a steam space, and a smoke box in advance of said shell, the smoke boxes of both boilers confronting each other and terminating in outwardly flared flanges, a common ring of greater diameter than said shells and of curvilinear cross section seated upon and connecting said flanges, cylinders assembled with said boilers, steam pipes leading from the steam spaces of said boilers to said cylinders, throttle valves in said steam pipes, and means for simultaneously operating both throttle valves from the outer end of either boiler.

CAST-STEEL UNDERFRAME FOR CARS.

1,039,403—Clarence H. Howard, St. Louis, Mo., assignor to Locomotive Tender Frame Company, St. Louis, Mo.

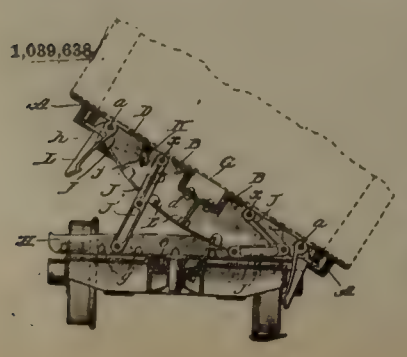
This is a cast steel underframe for cars having the combination of an end sill and longitudinal members, flanges of the latter forming a horizontal strengthening web, pocket walls depending from said strengthening web to form a central pocket and lateral pockets on each side of the central pocket.

CAR-TRUCK.

1,039,404—Clarence H. Howard and Harry M. Pflager, St. Louis, Mo., assignors to Double Body Bolster Company, St. Louis, Mo.

This is a car truck, having the combination with truck bolsters, of an H-shaped center bolster detachably applied to and supported by said truck bolsters, a center bearing plate detachably applied to the center member of said H-shaped bolster, and pairs of shoulders on the end portions of said center member, which shoulders engage the end portions of the center bearing plate.

1,039,638.



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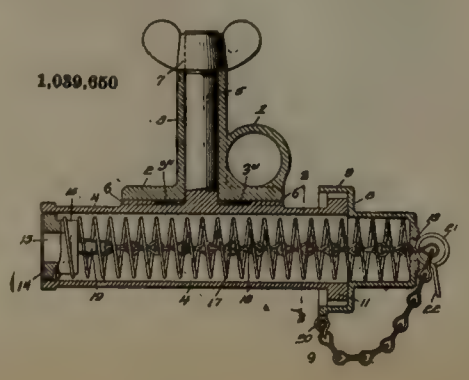

INDUSTRIAL NOTES.

The Buffalo Brake Co., New York, will open a branch office at Hamilton, Ont. The business and staff of the branch office now located at Brantford, Ont., will be moved to Hamilton.

The Dominion Forged Steel Car Wheel Co., Montreal, Que., has recently been incorporated and will construct a foundry for the manufacture of solid steel car wheels.

The American Car Screen Co. has received an order from the Seaboard Air Line to equip with Scott No. 2 adjustable car window screens, six new dining cars being built by the Pullman Co.

The Niles-Bement-Pond Co., New York, has opened a branch office at 336 West Fourth street, Cincinnati, Ohio, in charge of C. M. Pond.

The Pilliod Co., New York, during June, July and August, received orders for as much new business as during the entire fiscal year ended May 31, 1912.

RAILWAY MASTER MECHANIC

The World's Greatest Railway Mechanical Journal
Published at the World's Greatest Railway Center
Established 1878

Published by THE RAILWAY LIST COMPANY

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HEADLIGHTS.

One of the most interesting discussions ever heard by the members of the Western Railway Club as a body followed the reading before that association, October 15, of a report of tests of locomotive headlights. This report, which is published in part of another page of this issue, is the result of a series of tests made by the Wisconsin Railroad Commission, subsequent to the passing of a law bearing on the subject, by the state legislature. No definite conclusions are drawn by those who conducted the experimental work and hence the full discussion brought out some very valuable information.

The stipulations of the legislative act in question are such as to bar every headlight which was tried out with the exception of those operated by electricity. This was probably the purpose of the farmers and country lawyers who are responsible for passing this impractical and pernicious law. While at first thought it would seem that certain manufacturers of electric headlights would be benefited were the law to stand, a more careful study of the situation indicates the contrary to be the case. The electric headlight has proven a great boon in certain classes of railway service and its use has been extending rapidly in the particular field to which it is adapted. There are, however, other classes of service to which it is distinctly not adapted and to force its use in all classes of service would be no less than hazardous. A reversion of opinion which would soon amount to general prejudice of marked nature will follow attempts to legislate it into general use. It is therefore to the ultimate interests of the electric headlight manufacturers to fight such legislation. Certainly they should not aid or abett it.

In the discussion, above mentioned, the differences of opinion among practical men; the locomotive engineers, several of whom voiced their ideas, was entirely due to the differences in the operating conditions under which they work. The men employed on single track lines which are not completely equipped with automatic signaling systems favored the use of the high power headlight, whereas those who operate trains over multiple tracked lines equipped with block signals were opposed to this light. Among the officers who have to contend with both conditions, the opinion is unanimous that a general equipment of locomotives with the high power headlight is much worse than useless. The obvious conclusion is that the law which attempts to enforce the general use of the high power headlight cannot stand and the sooner it is repealed the better for all concerned. Without legislation the use of this very efficient device will naturally and healthily grow. A low power headlight, electric, gas or oil, which is looked upon more in the nature of a marker, will continue to give the best possible service on lines of more than one parallel track and which are equipped with automatic block signals. Such a low power electric headlight is now being developed. Its use will probably become quite general where the high power light is barred.

It is suggested that state legislatures could do more towards saving lives by handling the subject of railway right of way trespassing more stringently, than they can by attempting to force the use of make shift safeguards for such trespassers. A lesson may be learned from the fact that in England where

no headlights of any kind are used, accidents are very few. Trespassers are dealt with very severely in Europe.

EXPERIMENTAL WORK.

The practical test of any device or method is its behavior in actual service. Nevertheless the value of tests and experimental work in railway service as well as in other industries, cannot be questioned, furnishing as they do the most efficient developments for the practical test of service. It is a fact that those roads which maintain well established testing plants are the roads looked to as leaders. Materials or devices are not placed in service at once at a high expense but are tested with all possible accuracy and compared with similar devices or methods. Efficient testing departments are expensive to maintain and only the very largest systems can afford them. In fact even the largest systems cannot afford to maintain a very elaborate testing plant. Therefore the suggestion made at the Atlantic City conventions that means be appropriated to continue certain tests on superheated steam, was one that should commend itself to every mechanical man. Such tests are of interest and value to the railway mechanical fraternity in general and should be supported by it.

These tests are being conducted by unbiased parties and without regard to local conditions on any one road. There are a great many tests of similar character which could be conducted at some central experimental plant, to be located by the mechanical associations. Of course the idea of a central testing plant has been advanced a number of times and is by no means new but it seems to us that the most effective and economical method of accomplishing this end is by establishing such a plant at and under the auspices of some technical school. This will decrease the expense involved and will also give the plant the advantage of co-operating with other fields and interests, enabling it to do work of a broader scope and value.

SAFETY FIRST.

A safety first rally was held at Kansas City, Mo., on the evening of October 19, at which over 9,000 railway employees were present, representing all the roads entering Kansas City. A number of roads ran special trains bringing in employees from surrounding territory and the employees present ranged from general managers down to porters. Addresses were given by a number of prominent railway men on the subject of safety and a number of instructive moving pictures were shown. But the most remarkable thing in connection with this meeting was the spirit and interest in safety which could cause 9,000 railway men to meet together. It was not so much what was said at the meeting as what it in itself stood for.

A great deal has been said about increasing the safety on American railways recently and a great deal has been done in decreasing the number of accidents since the Chicago & North Western some two years ago started its "safety first" organization. Similar organizations have been put in effect on a great number of the large roads, and that they are doing much good is unquestionable. Safety inspectors have been appointed whose duty it is to safeguard all operations, first aid packets have been supplied in shops and every provision made to give those who unavoidably are the victims of accidents, all the aid possible. As a result, accidents on our railways which have been so startlingly numerous, are decreasing. But accidents cannot be very materially prevented by safety inspection and first aid packets. They can be prevented only by instilling in every man, a sense of the dangers by which he is surrounded, a sense of his duty towards his fellow workman as well as towards himself. Therein lies the value of a meeting such as the Kansas City meeting; therein lies the value of a safety organization. Each man who attended that Kansas City meeting must have been impressed by the fact that there were 8,999 people interested in his safety.

Accidents could have been decreased and prevented years ago if there had been enough officials interested in it to make a concentrated effort to interest their employees in it. It is all a question of getting enough people interested in it. If such a rally as the one mentioned can be successfully carried out in Kansas City, would it not be a good thing if a number of similar meetings were held in other large centers? A number of such meetings held in Chicago, New York, Pittsburgh, St. Louis, San Francisco and other large railway centers would be certain to greatly increase the interest in this subject. Such meetings can be held at a slight expense to each road involved and it is to be hoped that they will be carried out in the near future.

FREIGHT CARS.

The Pennsylvania has contracted, thus far this year, for twenty million dollars worth of freight car equipment. This amount covers orders for about eighteen thousand cars of which eight thousand are for the purpose of replacing scrapped equipment. Officers of the company point to these figures as illustrative of the efforts being made to preclude a car shortage. With respect to the bulk of the orders, however, it seems that they were placed only after the shortage was imminent, and that, owing to this fact, their construction is being pushed on rush orders at considerably greater expense than would have been the case had the situation been foreseen by a reasonable period of time.

A similar situation is noted in the repair departments of the Pennsylvania system. An official circular states that twenty-seven thousand employes are engaged in rush order work in the car and locomotive shops. This probably means overtime in most instances, the contrast between the present situation and that of several months ago is too great a one, economically speaking. It is safe to say that had the shops been worked to only the greater part of their capacity continuously through recent dull seasons, the work could not have piled up to such extent as to necessitate the rush work at present on order. The considerably greater expense of rush order repair work makes the possibility of such situations seem the result of unwise financial policies; yet it is aptly illustrative of conditions throughout the country.

ONE OF the latest results of Harrington Emerson's efficiency studies is the addition to his system as applied to large industrial

manufacturing organizations, of a "character reading expert." This "expert" reads the characters of the applicants for all positions, thus judging as to the availability, desirability and ability of the persons in question. This expert claims to be able to place a man in the work for which he is best adapted, thus securing best results for both employer and employe. The first "expert" installed in this work is a woman. To one not professing a great amount of efficiency organization experience in the Emerson systems, it would seem that any "expert" who claims the soothsayer's ability to judge as to the qualifications of any and all persons in detail industrial work, prior to trial, would be an impractical idealist.

TENDER DERAILMENTS.

Editor, *Railway Master Mechanic:* In the October issue of the *Railway Master Mechanic*, I notice an editorial on tender derailments. I think this subject very interesting, and will say that I have passed through a period of tender derailments, and I must say numerous tender derailments, and I am glad to report that my tender derailments are now nothing. At one time, some three years ago, it was hardly possible to keep our tenders on the rails and of course it was strictly up to me to remedy these troubles, if possible, which I did.

Before going into this matter any further, I will state that the tenders I refer to were practically new from the locomotive works. There were three changes made on the trucks, which I consider all that were necessary, namely: the shape of center casting, top and bottom, the clearance and location of side bearings and change from outside to inside hung brakes. The trucks of the tenders referred to, are arch bar trucks carrying double eliptic springs, wheel base of trucks, 4 ft. 10 in.; total wheel base, 15 ft. 3 in.; height from rail to bottom of cistern, 4 ft. 2½ in.; from the rail to the top of coping, 10 ft. ½ in.; capacity, 5,000 gallons of water, 11 tons of coal; weight of tender complete, 100,000 lbs. Will say that I am using this class of tenders in both freight and passenger service, will also state that track conditions are not the best, but at the same time, we are not having any derailments whatever from tenders.

As previously stated, at one time before the changes I have mentioned were made, it was hardly possible to get an engine over the road without a tender derailment, and there was hardly a day for a period of about six or eight months that we did not have a tender derailment. Will also state that I do not use splash boards to stop the motion of the water inside the cistern, as I do not consider them of any benefit whatever.

I understand that there are a great many roads throughout the country that are being troubled with tender derailments, and if I can be of any assistance to any of the mechanical officers, I will be more than glad to answer any question or give them any suggestion that might benefit them.

(Signed) J. J. Clark, M. M.,
Tennessee Central R. R.

Roofs for New Rock Island Cars

An order of 550 furniture and box cars has recently been completed for the Chicago, Rock Island & Pacific by the Pullman Co. and the Western Steel Car & Foundry Co. These cars have been equipped with a number of different types of metal car roofs with a view of determining the relative advantages and disadvantages of each and as these roofs are typical of the latest and best development in car roofs, we present herewith descriptions and illustrations of them. The type of roof and the number of cars so equipped are as follows:

50 cars with Franklin all-metal roof.
50 cars with Hutchin's all-metal roof.
50 cars with Murphy all-steel radial roof.
350 cars with Murphy XLA roof.
50 cars with Franklin outside metal roof.

Murphy Roof.

The details of the Murphy XLA roof are shown in figure 1. The sheets proper on this type of roof are made with two folds and these sheets are applied by slipping up each fold into the fold of its companion sheet, thus becoming interlocked. The sheets do not bend over the car as has been the custom, but they are equipped with a turnback, which hooks into a flashing at the eave. In other words, all of the sheets proper, are loosely engaged with a series of flashings at the eaves of the cars. This construction permits of the torsional movement of the cars without straining any portion of the roof. Each of the sheets on one side of the car fits into the fold of its neighbor on the opposite side and each four sheets is held by a four way galvanized iron ridge cap in the center of which is a bolt

Rock Island Automobile Car Equipped with Franklin Roof.

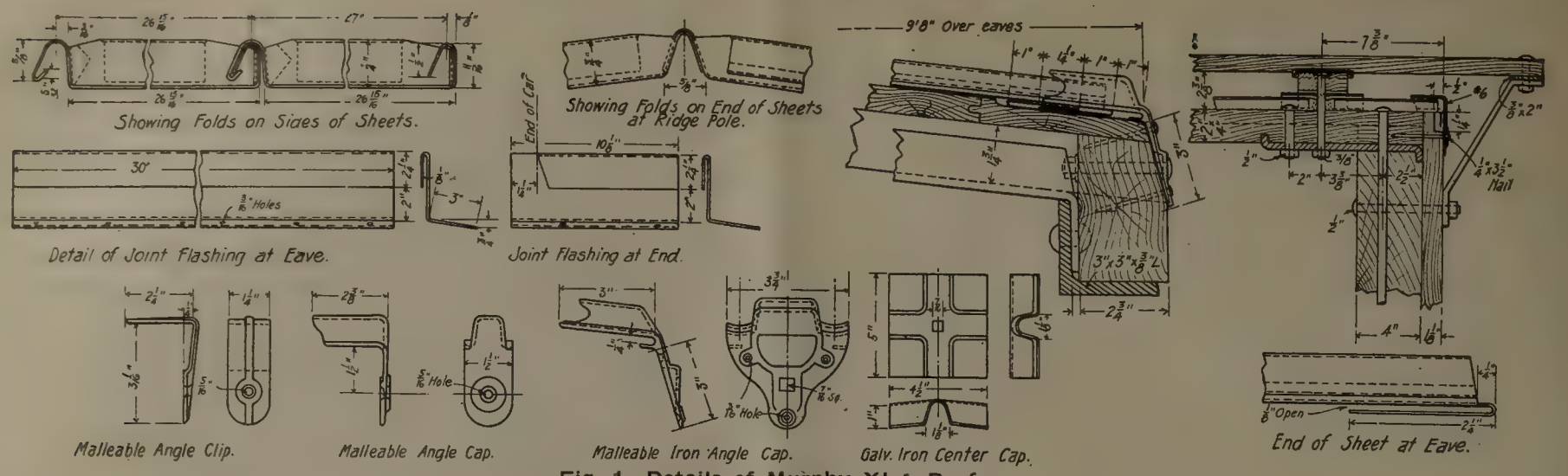
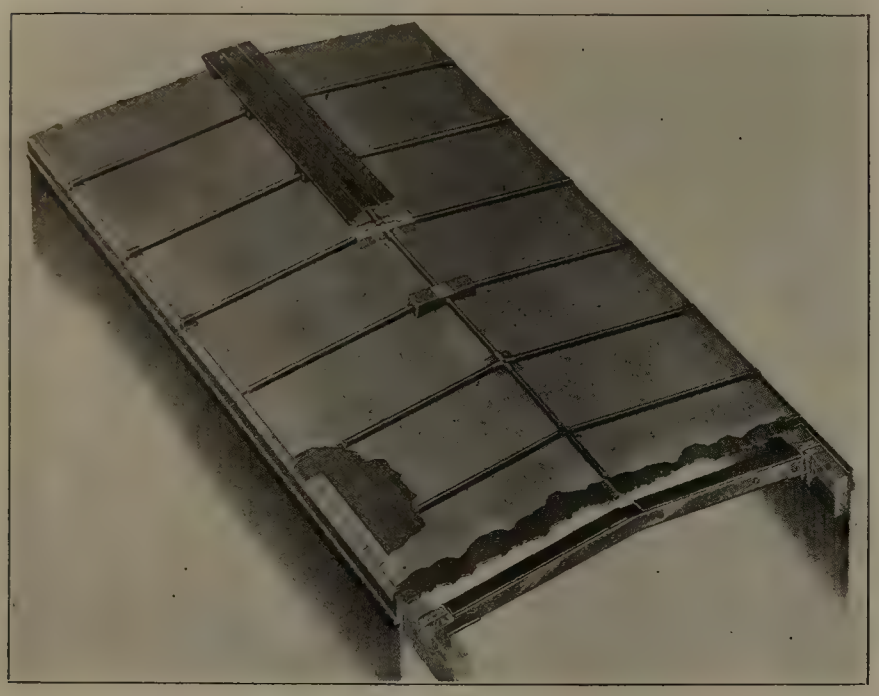

Showing Folds on Sides of Sheets.
Showing Folds on End of Sheets at Ridge Pole.
Detail of Joint Flashing at Eave.
Joint Flashing at End.
9'8" Over eaves
End of Sheet at Eave.
Malleable Angle Clip.
Malleable Angle Cap.
Malleable Iron Angle Cap.
Galv. Iron Center Cap.

Fig. 1—Details of Murphy XLA Roof.



Murphy XLA Roof.

hole which allows for a bolt to be dropped down through the saddle of the running board, through the bolt hole in said cap and through the ridge pole. This bolt does not come in contact with the sheets but passes through the space between the four ridge corners thereof. The bolt mentioned is covered by a galvanized bolt head cover, which prevents any water following the bolt. The turn-down on either side of the bolt head covers, fits into the saddle; the saddle being grooved for the bolt head covers. Hood casting pattern 2-C is bolted to the eaves and covers each fold, angle casting 15-C is used at the ends and hood casting No. 6 at the ridge, one on each end of car.

While bolts and nails are employed to retain the hood castings and clips, the sheets are not in any way, pierced by either the bolts or nails, being allowed free and easy movement under each hood and clip. The hoods are made sufficiently wide for any undue sheet movement and besides these castings have a wide tendency to absorb the shock which the sheets might receive.

Details of the Murphy all steel radial roof are shown in figure 2. Sheets on this design are curved and extend clear across the car being loose at the eaves. Between each two sheets, there is a T carline and over all is placed a galvanized steel cap extending clear across the car.

The space between the carlines and the turned up portion of each sheet, likewise the space between the sheets where they turn up and the cap affords great flexibility and precludes the possibility of a binding of a sheet with the cap or the sheets with the carlines. The cap is held in position by a bolt, the head of which is fastened in the up-standing leg of the carline, passing up through the cap and the malleable iron bolt lock, over which is fitted a nut, which is locked in position as may be noted, in the drawing. There is no sheathing used in connection with this roof, carlines and purlins being steel. Casting No. 23, is used at the ends of the car, casting No. 26, is used in holding the cap and casting No. 27, is a washer and is used in connection with No. 26. The running board saddle is held in position by two bolts one on either side of the center; these bolts being fitted into the upstanding leg of the carline. These are used where two sheets join together. Each running board saddle is grooved for the reception of galvanized bolt covers, which cover up the heads of the two bolts which pierce each saddle. With this type roof the ridge pole is omitted.

Franklin Roof.

Fig. 3 shows a section and details of the Franklin roof. The roofing sheets of the Franklin roof rest directly on the side and end plates, steel carlines, steel purlins and steel ridge pole. The edges of the sheet which are adjacent to the carlines and ridge pole, have up-turned and then

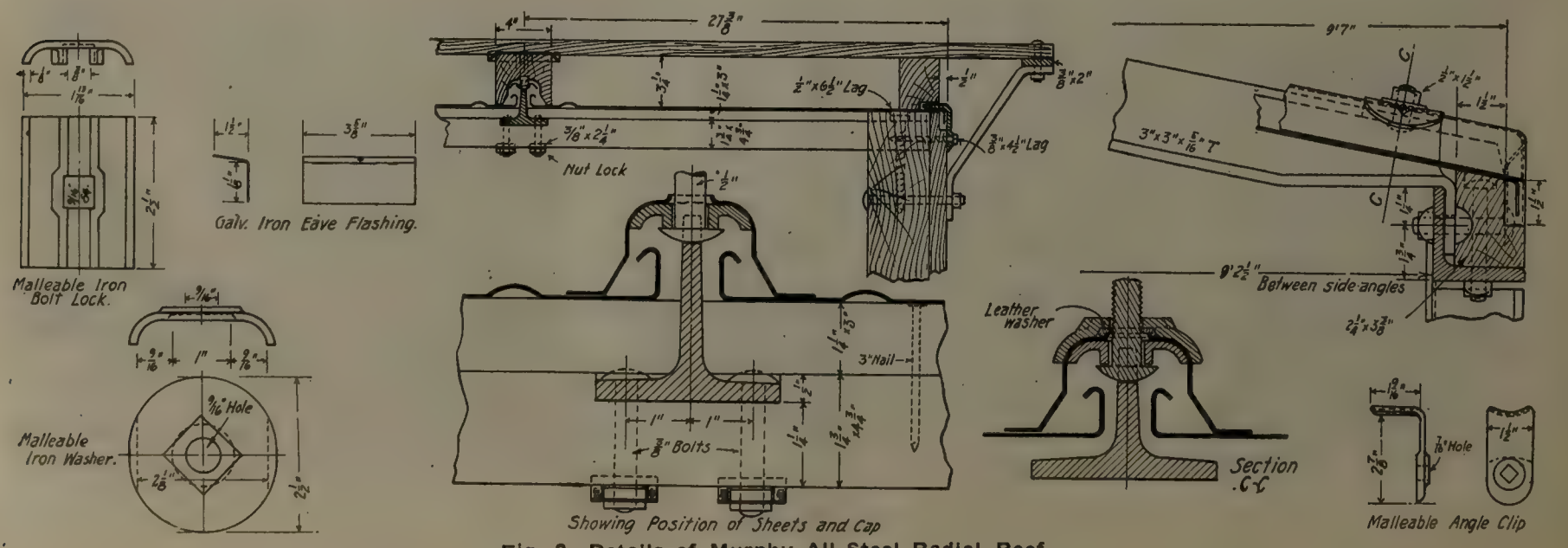


Fig. 2—Details of Murphy All-Steel Radial Roof.

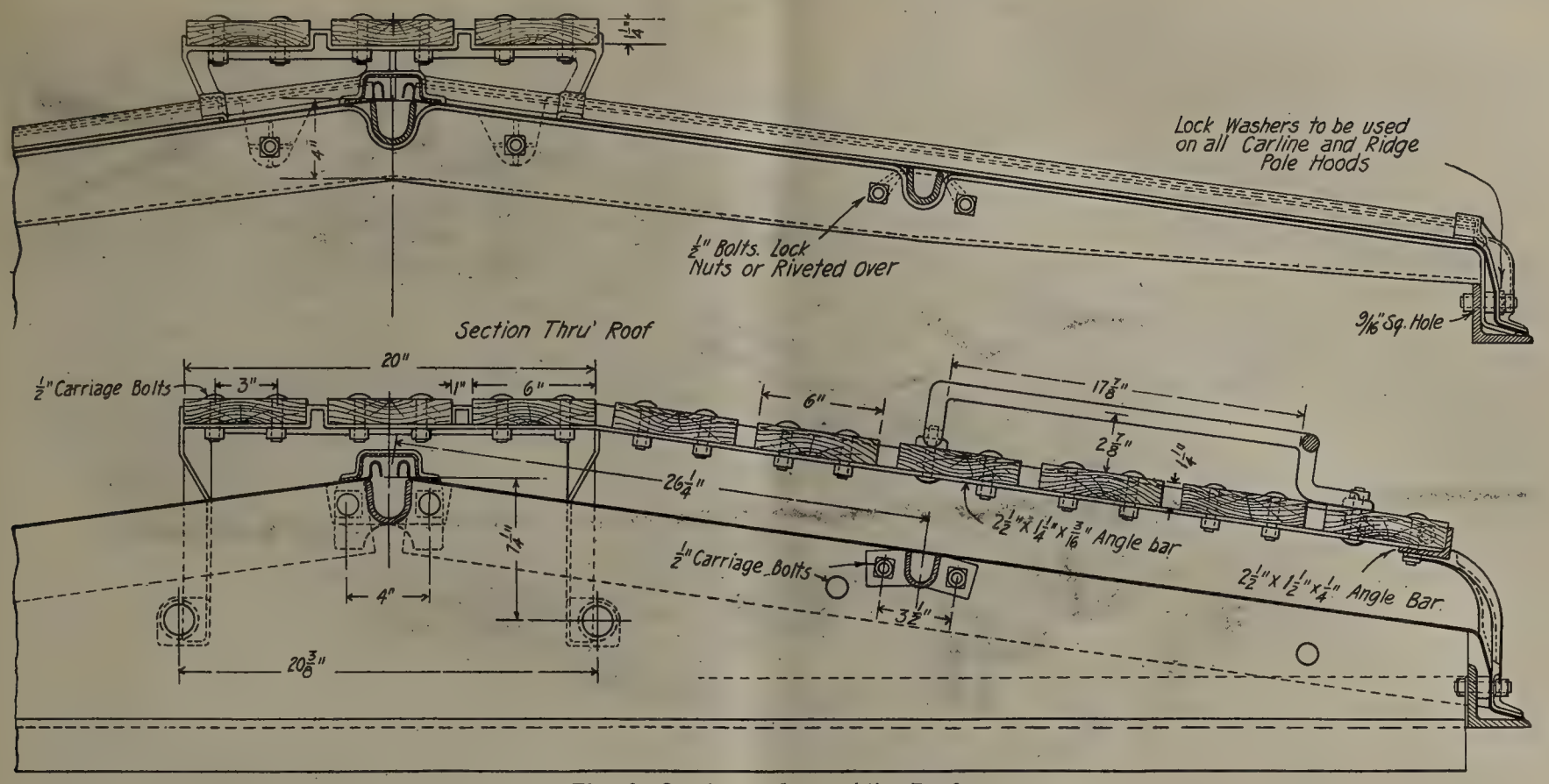


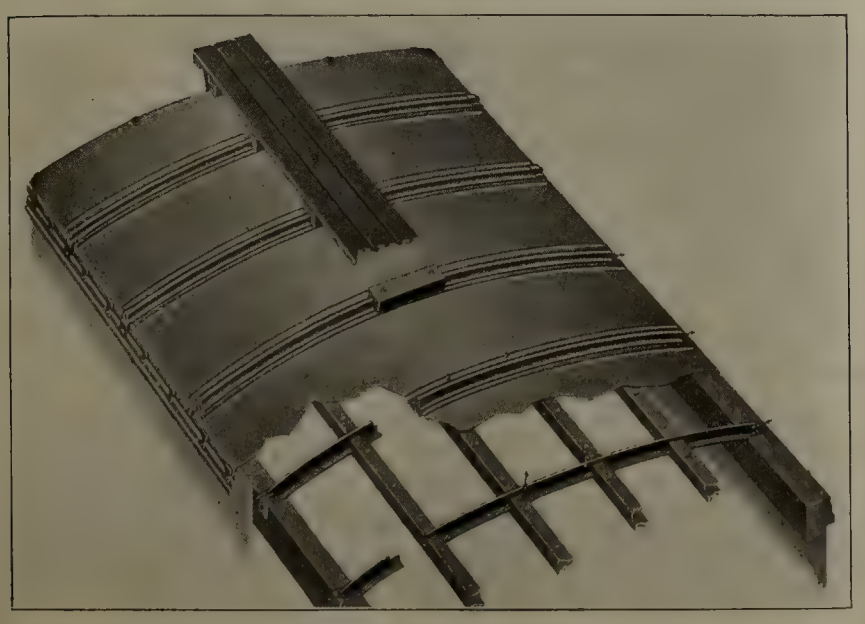
Fig. 3—Sections of Franklin Roof.

down-turned edges extending slightly below the top face of the carlines and ridge pole and the edges of the sheets which coincide with the sides and ends of the car, are turned down over the side and end plates. The portion of the sheets which extend over the side and end plates have a large radius at the bend, and the lower ends of the sheets are flared out to lap over the top edges of the fascia boards. The sheets are secured at the eaves and ends of the car by square-necked collar bolts which pass through the down-turned flanges and the side and end plates of the car. These bolts are provided with collars to prevent any water following the bolts through the side plates and into the car. The roofing sheets are held down at the carlines and ridge pole, but not rigidly secured by the carline and ridge caps.

The running board saddles are made of malleable iron and are arranged for three 6-in. boards, the boards fastened to the saddle by carriage bolts. To keep the boards in line the top horizontal member is provided with projecting lugs at the ends and between the boards. Small corner projections are also employed which enter the boards at their edges, thus preventing them from shifting endwise From the underside of the saddles extend two lugs provided with holes near their ends. Horizontal bolts pass through these holes and the walls of the carlines, thus the entire weight of the saddles, running boards and anyone passing over them is taken directly by the carlines, and as the saddles are placed at a fixed distance above the carlines the roofing sheets cannot become bound or pinched. The saddles are provided with pockets for receiving the ends of the carline and ridge caps.

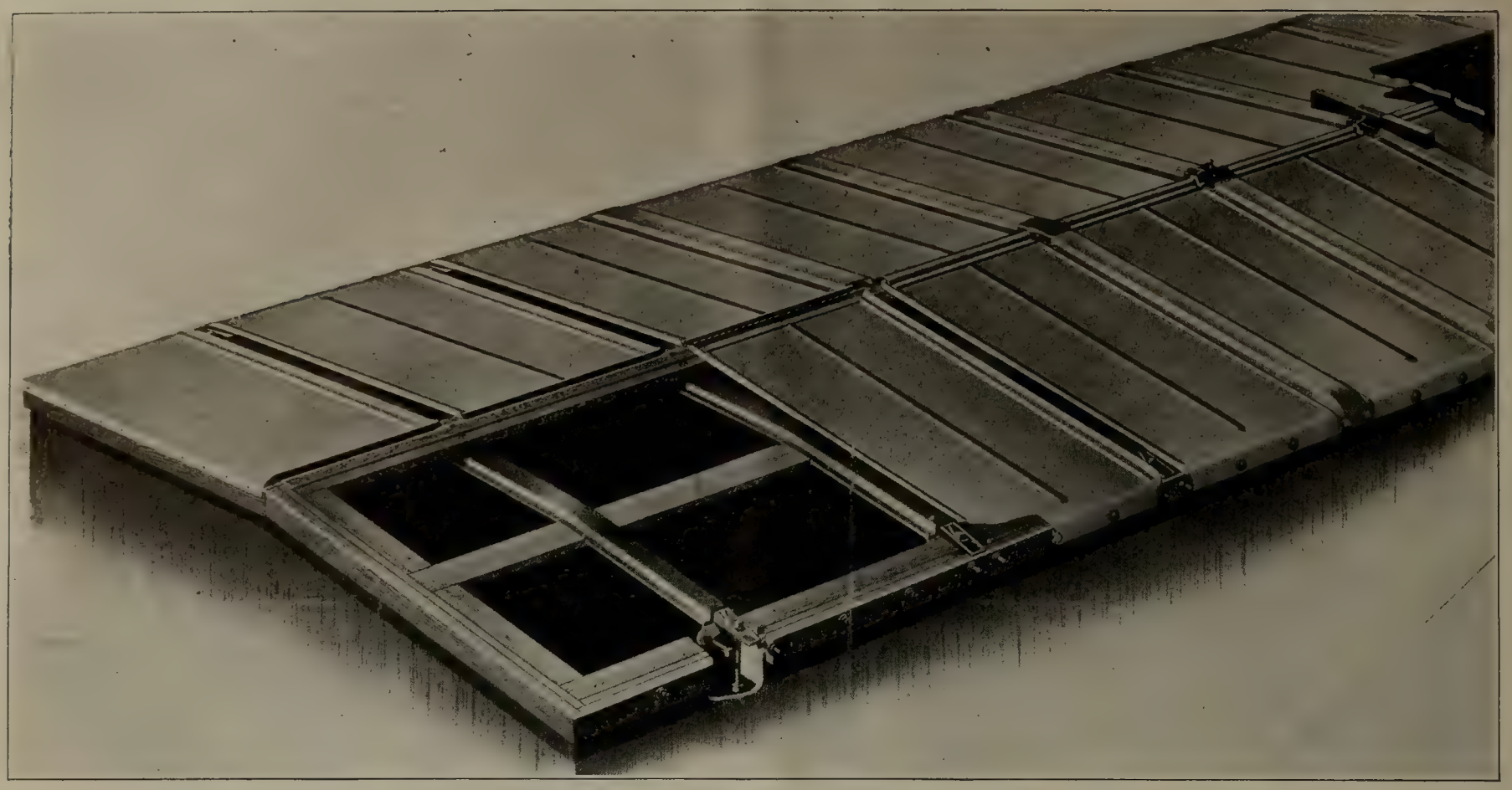
At the ends of the carlines are placed malleable iron hoods which prevent the entrance of dirt and cinders, but arranged to permit of the exit of water from the trough of the carlines. The carline hoods are also arranged so as to hold in place the carline caps at the eaves of the car. The hoods are attached by the same two horizontal bolts which are used for fastening the carlines, thereby making a metal to metal connection. At the ends of the ridge pole there are malleable iron hoods to prevent the entrance of cinders or other foreign matter, but designed so as to permit of the exit of water from the trough of the ridge pole.

The carline caps are fastened by their outer ends fitting into pockets in the carline hoods, and their inside ends into pockets in the running board saddles. The intermediate ridge caps are secured by their ends fitting into pockets in



Murphy Radial Roof.

Interior of Car Equipped with Franklin Roof.



Hutchins All-Steel Car Roof.

the running board saddles. The end caps are fastened by their outer ends fitting into pockets in the malleable iron ridge pole hoods, and their inside ends into pockets in the running board saddles.

A series of water and flexibility tests were recently made on Franklin roofs to some roofs applied on different railroad companies' cars throughout the country in which the water pressure was ninety pounds per square inch, using with a 7/8-in. nozzle. The car was jacked up 6 in. at one corner, thus giving the entire body a twist, and the roofing sheets moved freely to the extent of 3/8 in. While the car was in this distorted condition, the hose was taken to the top and water thrown over the entire roof, the nozzle being held close to the ridge and carline caps, and no water passed through.

The carlines are of pressed steel, "U" shaped in section, extending through the side plates, the plates being gained to receive them, thereby placing the top edges of the carlines on the same plane as the side plates. The ends of the carlines are turned down, and the carlines are fastened by two horizontal square-necked collar bolts passing through this turned-down portion and the side plates of the car. The same bolts which are used for attaching the carlines are also used for securing the roofing sheets and carline hoods at these points. The ridge pole and purlins pass over the carlines at the depressed sections, thus placing their upper edges on the same plane as the top edges of the carlines. The sides of the purlins are cut out where they pass through the carlines to receive the purlin-carline keys. A hole is placed at the bottom of the ridge pole and purlins where they intersect the carlines, forming a drain from these members to the carlines. The top edges of the ridge pole and purlins are flush with the top of the end plates. The ridge pole extends through the end plates, which are gained to receive it, but the purlins only extend to the inside face of the plates. Both the ridge pole and purlins are flanged out at their ends and are fastened by two horizontal bolts which pass through these flanged-out portions and the end plates. The running board brackets are formed in one piece, the boards being attached to the top connecting member by vertical carriage bolts. The running board side extension supports are made of rolled steel angle bars. The inside ends are attached to the running boards by vertical carriage bolts, which pass through the horizontal legs of the angles, the vertical legs being cut off at these points. At their outer ends they are carried by the running board end extension supports and the running board extension brackets.

View of Completed Cars at the Plant of the Western Steel Car & Foundry Co.

Hutchins' All-Steel Roof.

The Hutchins' car roof is claimed to be the original steel car roof and the first flexible steel roof applied to a freight car. It is said that this roof allows the greatest amount of head room. The carlines are of rolled steel fabricated in the shops of the company. Roofing sheets, carline caps and ridge caps are made of 1/16-in. galvanized steel plate. At the eave of the car the down-turn flange of the roofing sheets is offset from the fascia, thus giving an air space and preserving the life of the downturn flange of the roofing sheets as well as the fascia. This also allows any drip to get off the car. Roofing sheets are what are called two-plane, the lower plane carrying the water off the car; the upper plane preventing any water, cinders or dirt from getting underneath and between the carline cap and the sheet, or the ridge cap and the sheet.

Headlight Tests*

By C. M. Larson, Asst. Chf. Engr., Railroad Commission of Wisconsin.

During the 1911 session of the Legislature of Wisconsin the following law was passed:

"Locomotive Headlights. Section 1809v. 1. It shall be the duty of every corporation operating any steam railroad of more than fifty miles of track within this state, to equip on or before July 1, 1912, every locomotive, power vehicle, power car, and other equipment used as the equivalent of or in place of locomotives, except such as are used exclusively for switching service or in railroad yards and not elsewhere, with a headlight of sufficient candlepower, measured with a reflector, to throw a light in clear weather that will enable the operator of the same to plainly discern an object the size of a man, at a distance of not less than eight hundred feet, and thereafter to maintain and use such headlights upon every such locomotive, vehicle car or other equipment, when the same is operated at nighttime."

It will be noted that this law became effective on July 1, 1912. Early in the year inquiries were sent by the commission to the various railroads operating in Wisconsin to learn what steps had been taken in anticipation of this law going into effect. At the same time inquiries were sent to various concerns who are in the business of supplying headlights with a view of obtaining descriptions of such apparatus.

*From a paper read before the Western Railway Club, Oct. 16, 1912.

While this is not one which the railroad commission is expected to administer, yet it was felt that inasmuch as the commission is interested in the safety of operation of railroads and as experiences in other places appear to have shown that some complications might arise when high power headlights are used on tracks equipped with numerous signal lights, it was thought that the whole matter would be placed on a more satisfactory basis if the commission was to co-operate to some extent.

After some correspondence on the subject with officers of the C., M. & St. P. Railway, it was agreed that the engineers of the Railroad Commission of Wisconsin would co-operate with representatives of that company in making a series of tests to determine whether or not the Bunn safety headlight would comply with the provisions of the law. Accordingly a committee consisting of Professor J. G. D. Mack, of the University of Wisconsin, who was also head of the mechanical department of the railroad commission, as chairman, Mr. M. H. Hovey, safety service expert, and Mr. J. N. Cadby, inspector of Gas and Electric Service of the commission, was instructed to make arrangements to carry out the necessary tests. The following extract from a report by Mr. Cadby explains the first work carried on:

"On the night of May 6th, preliminary observations were made by the committee and other members of the staff of (1) an ordinary standard headlight which had been in service for several months, (2) a new lamp of the same type, and (3) a Bunn

American Electric Headlight.
Made June 10, 1912.
Engine No. 1348, C. & N. W. Ry
Weather: Dark and Cloudy.

STANDING TEST

Objects:—One man in white walking between rails. One man in dark walking outside west rail.

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT						
		A 11 2020 Feet	A 12 1720 Feet	A 13 1420 Feet	A 14 1170 Feet	A 15 930 Feet	A 16 660 Feet	A 17 470 Feet
2	Left running board	Light looking object n center of track	One person in center of track	One person light or brown color, center of track	Light person center track and one dark person outside rail, East side. Face on latter plain	Same	Light coat on person in center. Dark coat on person side of track	Two persons plainly visible
1	Front of engine.....	Man—brown	Man in brown	Same	Black—brown	Same—white face	Same	Same
3	—	Object—light	Same	Same	Object, light, good	2 men, black and white	Same	Same
5	Front of engine.....	1 dark object to left	1 dark object to right	1 dark object center	1 dark object left: 1 light object center	1 dark person left—1 light person center	1 dark person, left 1 light person right	1 dark person with white collar 1 light person
9	Left end front bumper beam	Light object—very dim like a spot between rails	Light spot between rails	Light object like a spot between rails	Man in light suit between rails	Man in li ht suit between rails—man in dark suit outside left rail	Same as A 15	Same as A 16 Could see that they were walking toward me
10	Pilot	X	Object about size of whistle post	Same	Object about size of man with white or light coat	2 objects—1 light, 1 dark	2 men clearly walking	2 men
11	Front of engine..... . ..	X	X	White mark	White object	White object	Man in light and one in dark clothes	See both men plain
16	Left side cab..... ...	X	Light—one	Light—1 dark—1	Same	Same	Same	Same
18	Left seat box in cab	X	X	Light object	Same	Light and Dark man	Light and dark man, also man on opposite track	2 men
19	Left seat box in cab	X	X	X	X	Light object	One light, one dark man	Same
20		Light object	Light object moving	Light object moving	Light man between rails	Light man walking between rails. Dark man walking on left rail	Light and dark man walking on track	Man in dark clothes, woman in light, walking on track
21	Ground ahead of engine..	White object center of track	White object center of track—looks like a white post	Same	Same	Person in white suit walking on center of track	2 persons walking on track—one white suit, other in black	Same
22	Ground front of engine..	X	X	X	Man dressed in light clothing	2 men—one in light clothes, one in dark	2 men, light and dark	2 men—light and dark clothes
23	Ground front of locomotive.....	X	X	Object in track	Man in light clothes	2 men—one light, other dark clothes	Same	Same
24	Ground right of pilot....	X	One dark man very dim	One dark and one light man	One dark and one light man—very dim	One dark and one light man—some plainer	One dark and one light man—brighter or plainer	Dark and light man—very plain
25	15-feet ahead of engine in track.	White speck	Dim mark	Light coat, dim	Same, more plain	Plain, also man in black	Both plain	—
26	—	Light spot, hardly seen	Light post or spot	Looks like post on track	Light object like man	Light man seen walking	2 men—1 light and 1 dark—face only dark one seen	2 men, one dark, one light—face dark man only good

X Indicates "nothing visible."
— Indicates "no observation made."

American Electric Headlight.
Observation, June 10, 1912.
Engine No. 1348, C. & N. W. Ry.
Weather: Dark and Overcast.

TABLE V

RUNNING TEST

Object:—On : man in gray suit standing in center of track at station 20+00.

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT			
		B 1 1625 Feet	B 2 1550 Feet	B 3 1300 Feet	B 4 1100 Feet
2	Left running board	X	Faint object	Plain object	Plain object, man seen in center of track
3	—	Light spot	Same	Light man	Same
5	Behind cab	1 person crossing tracks	1 person off track on left	Person on track ahead	1 person lying on face at side of track
9	Left side, steps above bumper	X	Light spot between rails	Same	Light object—vertical between rails
11	Front end of engine	X	X	Object	—
16	Left side of cab	X	X	White, one	Same
18	Engineer's seat in cab	X	X	Light object	Same
19	Left seat box in cab	X	X	X	Light object on tracks
20	Left seat of cab	X	X	X	Light object on track
21	Pilot	X	X	White object on track	Person in center of track
22	Right side of cab	X	X	X	X
24	—	X	X	One light man	Same

X Indicates "nothing visible."
— Indicates "no observation made."

American Electric Headlight.
Observation, June 10, 1912.
Engine No. 1348, C. & N. W. Ry.
Weather: dark and overcast.

TABLE VI

RUNNING TEST

Object:—One man in white standing in center of track at station 25+00.

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT			
		B 11 2125 Feet	B 12 1950 Feet	B 13 1750 Feet	B 14 1565 Feet
2	Left running board	X	Light object	Light object	Person in white, plain
3	—	White object	Same	Same	White man
5	Behind cab	X	Object on truck	Light object	Same
9	Left end bumper beam	X	Light spot between rails	Same	Vertical object between rails
11	Front end of engine	X	X	Object	—
16	Left side of cab	X	X	White—one	Same
18	Engine cab	X	X	An object	Same
19	Left seat box in cab	X	X	X	Faint light object on track
20	Left seat box in cab	X	X	X	Light object
21	Pilot	X	X	White object in center of track	White object center of track—looks like whistle post
22	Right side of cab	X	X	X	X
23	Gangway of cab	X	X	Object on track	Object on track

X Indicates "nothing visible."
— Indicates "no observation made."

Pyle National Headlight.
Observation, June 11, 1912.
Engine, C. & N. W. Railway.
Weather: dark and clear.

TABLE VIII

STANDING TEST

Object:—One man in white suit walking between rails

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT					
		M 1 2445 Feet	M 2 2120 Feet	M 3 1795 Feet	M 4 1460 Feet	M 5 1150 Feet	M 6 820 Feet
2	Left side on pilot	White object size of person center of track	Same—very plain	Same	Same	Same	Same
5	Front of engine	White object	Same	Same	Same	Same	Same
9	Right side on pilot	White spot between rails	Same	White vertical object between rails	Man in light suit, between rails	Man in white suit between rails	Same walking toward engine
10	Pilot	Light object in center of track	Same	Same	Same	Man walking on track dressed in light suit	Same
11	Front end of engine	Object	Object or face of person appears white	Moving object	Same	Man in white clothes	Same plainly walking
18	Left seat of cab	White—1	Same	Same	Same	Same	Same
21	Track ahead of engine	White object on track	White object on track—looks like whistle post	White object walking on track	Person in white walking on track	Man dressed in white walking on track	Same
22	Ground front of engine	X	Man walking on track	Man with light coat	Man walking on track	Man in center of track dressed in white	Man walking on track

X Indicates "nothing visible."
— Indicates "no observation made."

down draft oil light with 16-inch lens. These observations were made under unfavorable conditions as regards surroundings, being made on ground where no rails were laid and where the surface was dark and irregular. The following is a summary of the observations:

"A man in dark clothes walking away from the Bunn light disappeared at about 350 feet. A man in medium, mixed suit disappeared at about 300 feet when viewed by the Bunn light, at about 280 feet when viewed by the new 'Standard' light, and at about 180 feet when viewed by the old 'Standard' light. A man in white shirt and black trousers disappeared at about 600 feet when viewed by the Bunn light as compared with 400 feet to 450 feet with the lamps of the other type."

Following the above preliminary observations a series of road tests was made on the night of May 9th in co-operation with representatives of the C., M. & St. P. Railway. There were also present representatives of several other railroads and of the University of Wisconsin, as well as Mr. J. W. Bunn, inventor, and Mr. E. W. Hodgkins, of the Dressell Railway Lamp Works, makers of the Bunn lamp.

A piece of straight track was selected about six miles west of Madison on the Prairie du Chien division and a stretch 1,300 feet in length measured off, a marked stake being driven side of the track at each station. Men were located at regular intervals along this stretch for the purpose of observing and recording the position of the "object" or of the engine during the tests.

Engines No. 511 and No. 1452 had been equipped with the necessary lights by the railway company and the tests were conducted in the following manner:

First Standing Tests. The locomotive carrying the test headlight was placed with its headlight opposite station zero of the course and men dressed in various colored clothing approached along the track from a point beyond the range of vision. The observers were stationed in the cab, on the tender, or on the ground near the engine, and as soon as any one detected the

approaching "object" he gave the signal to "blow" when the whistle was sounded and the object approaching stopped advancing. Each observer was then required to record what he observed, after which at two blasts of the whistle the advance was again taken up. At regular intervals thereafter the whistle was sounded and at each stop each observer recorded what he saw. The men stationed along the right of way and concealed from view of observers in the meantime recorded the location of the "object" at each blast of the whistle. In no case did the observers know what was to be expected before the object was seen.

Second Running Tests. An object consisting of either one or more men, or a dummy, was placed on the track at a point unknown to the observers, who were stationed in the cab, on the

Pyle "National" Headlight.
Observation, June 11, 1912.
Engine, C. & N. W. Ry.
Weather: dark and clear.

TABLE XIV

RUNNING TEST

Object:—One man in gray suit standing between rails at station 25+00.

No. of Observer	Position of observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT			
		N 11 2000 Feet	N 12 1850 Feet	N 13 1625 Feet	N 14 1460 Feet
2	Left side on pilot	*Faint object on track	Gray object on track	Gray object size of man, plain	Same
5	Pilot	X	Light colored object	Same	Same
9	Right side on pilot	X	X	Light spot between rails	Light object between rails
10	Pilot	Light object	Same	Man in light clothes	Same
11	Pilot	X	X	Object	—
16	Left side of cab	X	X	X	Light-1
21	Pilot	Object on track	Object moving on track	Man in gray walking on track	—
22	Pilot	Object	Same	Person in gray clothes	Same

X Indicates "nothing visible."
— Indicates "no observation made."
* Observers on pilot picked up object 100 feet before first blast of whistle.

Pyle "National" Headlight,
Observation June 11, 1912.
Engine C. & N. W. Ry.
Weather: dark and clear.

TABLE XV

RUNNING TEST

Object:—One man in white suit standing between rails at station 40x00.

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT			
		N 21 3600 Feet	N 22 3450 Feet	N 23 3300 Feet	N 24 3050 Feet
2	Left side on pilot	*Faint object on track	Same	Light object size of person—fairly plain	Man in gray suit, on track
5	Pilot	Faint object on center	Same	Gray person center	Same
9	Right side on pilot	X	X	X	Light spot between rails
10	Pilot	Very small object	Same	Light colored object	Same
11	Pilot	X	Object seen faintly	Same	—
16	Left side of cab	X	X	X	White—1
21	Pilot	White object on track	Same	Same	—
22	Pilot	X	X	X	Light object

X Indicates "nothing visible."
— Indicates "no observation made."
* Observers on pilot picked up object 100 feet before first blast of whistle.

18-inch "Commercial" Acetylene.
Observation, June 15, 1912.
Engine No. 840, C. M. & St. P. Ry.
Weather: Dark and clear

TABLE XXVIII

STANDING TEST

Object:—One man in white suit walking in track.

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT				
		V 1 1180 Feet	V 2 1010 Feet	V 3 805 Feet	V 4 580 Feet	V 5 430 Feet
2	Ground in front of engine	Faint light object in track	Light object size of man	Person in white suit—plain	Man in center of track—very plain	Same
5	Cab	X	I Light object	Same	One light person	Same
8	Right gangway of cab	White shadow	White	Light object on right rail	Tall light object moving—man	Man—very plain
9	Step—left side of pilot	X	Light spot between rails	Light vertical object between rails	Man in White between rails	Same approaching
12	—	Object on track	Light object on track	Person on track	Person in light clothes on track	Man in light clothes turning to right
13	Pilot	Object on track	Object moving on track	Person walking on track	Person in light clothes	Man walking in light clothes
14	Driving engine	Light object on track	Man walking on track	Man coming nearer	Man walking	Same
16	Cab—left	X	White	Same	Same	Same
17	—	White	Same	White man	Same	Same distance

X Indicates "nothing visible."
— Indicates "no observation made."

18 inch "Commercial" Acetylene
Observation, June 15, 1912
Engine No. 840 C. M. & St. P. Ry.
Weather: Dark and Clear

TABLE XXIX

STANDING TEST

Object: One man in black suit walking in center of track

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT				
		V 11 555	V 12 480	V 13 405	V 14 380	V 15 280
2	Ground in front of engine	Object in black size of Man	Same	Person in dark clothes on track	Same	Same
5	Cab	One dark object white spot	Same	One dark person white face	Same	Same
8	Right gangway of engine	Black Shadow	White face	Black shadow and white	Black object with white pants	Black shadow with white
9	Step, left side of pillot	Light spot between rails.	—	Man in dark between rails	Same	Same
12	—	Object on traci	Same	Dark object moving on track	Person in dark clothes moving on track	Same
13	Pilot	Something on track	Object moving	Person in dark clothes	Man walking in track	Man in dark clothes
14	Driving engine	Dark object on track	Same	Man walking on track	Man walking across track	Man opproaching
16	Cab—left	X	Black	Same	Same	Same
17	—	Dark man	Same	Black man	Same—plain	Same

X Indicates " nothing visible."
— Indicates " no observation made."

tender, or on the front end of the engine. The engine was first backed well away from the measured course and then run forward at six to ten miles per hour. The first observer to distinguish the object gave the signal to "blow" and the whistle was sounded at regular intervals of a few second until the object was reached. Each observer then recorded what he saw at each sounding of the whistle. The men along the track, who were concealed from view, recorded the position of the front end of the engine at each blast.

The following persons were selected as observers during the test of May 9th:

1. Mr. C. M. Larson, Asst. Chief Engineer, Railroad Commission.
2. Prof. L. V. Ludy, University of Wisconsin.
3. Mr. W. A. Alexander, Dist. Master Mechanic, C., M. & St. P. Railway.
4. Mr. R. H. Morrison, Engineer of Tests, C., M. & St. P. Railway.
5. Mr. J. W. Cyr, C., B. & Q. Railroad.
6. Mr. H. C. Zantow, Asst. Mech. Inspector, Railroad Commission.
7. Mr. Cooper, Fireman of No. 511, C., M. & St. P. Railway.
8. Mr. McCann, Engineer, C., M. & St. P. Railway.
9. Mr. Ziel, Engineer of No. 511, C., M. & St. P. Railway.
10. Mr. Graves, Engineer of No. 1452, C., M. & St. P. Railway.
11. Prof. E. Bennett, University of Wisconsin.

The observations of these tests of the 18-inch Bunn Safety Headlight are given in detail in tables A to 1 inclusive.

Two tests were also made with a new standard 16-inch round case headlight using safety B. oil. Also in a further test a man in medium light suit walking away from this light disappeared to most of the observers at about 400 feet, while a man in dark blue was lost at about 300 feet.

After the tests above described had been made it was decided to broaden the scope of the investigation to cover several types of headlights which might be proposed for use in the state. In order that the investigation might be as complete as possible, the tests were made with two objects in view, namely:

1. To determine the distance that an "object the size of a man" could be seen on a dark clear night, and
2. To observe what effect, if any, the various headlights might have on signal and classification lights.

In accordance with the above the same committee took the matter in charge. The Chicago & Northwestern Railway Company offered the use of its tracks on the Madison division south of Madison, where a straight piece of track was available, and where use might be made of the interlocking tower at South Madison for the signal tests.

These tests were made on June 10th, 11th, 14th and 15th. The engines and train crews were furnished by the Chicago & North-Western Railway Company on June 10th and 11th, and by the Chicago, Milwaukee & St. Paul Railway Company on June 14th and 15th.

During these four nights tests were made on the following headlights:

1. American Electric.
2. Pyle National Electric.
3. Commercial Acetylene, 18 in. and 27 in.
4. The 18 in. Bunn Safety oil headlight.

It was decided to repeat the tests on the Bunn Safety light on the tracks of the Chicago & North Western Railway in order that results might be compared with those obtained with other lights.

The tests are necessarily of two distinct types. Those made for effect on signals will be given in Part II, while the obstacle tests will be given in Part I.

Part I—Obstacle Tests.

A straight stretch of the south bound main track of the Chicago & North Western Railway of sufficient length just south of South Madison was measured off and stakes set as described in the test of May 9th. This course is on an embankment varying in height from two or three feet at the north end to some 25 feet at the south end. The ballast is a good grade of gravel, extending well outside of the tracks and completely filling the space between the two tracks.

In general three sets of observations were made with each light, both in the "standing" and in the "running" tests. These three sets were made with men wearing different colored suits of clothes, as objects. In no case did the observers know what kind of an object to expect, and in the "running" tests the objects were placed at various points along the course, unknown to the observers.

The observations and records were made as described in the test of May 9th, and the following persons acted as observers during the four nights in June. These persons were also observers in the signal tests of the same date described in Part II.

1. Mr. David Harlowe, Member Railroad Commission of Wisconsin.
2. Mr. C. M. Larson, Assistant Chief Engineer, Railroad Commission of Wisconsin.
3. Mr. M. H. Hovey, Safety Service Expert, Railroad Commission of Wisconsin.
4. Mr. J. N. Cadby, Inspector of Electric Service, Railroad Commission of Wisconsin.
5. Mr. H. E. McWethy, Asst. Field Inspector, Railroad Commission of Wisconsin.
6. Mr. L. F. Boon, Asst. Field Inspector, Railroad Commission of Wisconsin.
7. Mr. H. C. Zantow, Asst. Field Inspector, Railroad Commission.
8. Mr. J. H. Sloan, Asst. Field Inspector, Railroad Commission.
9. Mr. W. A. Alexander, Dist. Master Mechanic, C., M. & St. P. Railway.
10. Mr. R. H. Morrison, Engineer of Tests, C., M. & St. P. Railway.
11. Mr. P. G. Valentine, Draftsman, C., M. & St. P. Railway.
12. Mr. P. J. Borgard, Engineer, C., M. & St. P. Railway.
13. Mr. Wm. E. A. Slightam, Engineer, C., M. & St. P. Railway.
14. Mr. F. M. Bird, Engineer, C., M. & St. P. Railway.
15. Mr. A. Hessman, Engineer, C., M. & St. P. Railway.
16. Mr. F. R. Melcher, R. F. of Engineers, C. & N. W. Railway.
17. Mr. A. M. Ross, R. H. Foreman, C. & N. W. Railway.
18. An observer (Locomotive Engineer), C. & N. W. Railway.
19. An observer (Locomotive Engineer), C. & N. W. Railway.
20. An observer (Locomotive Engineer), C. & N. W. Railway.
21. Mr. E. L. Gingrase, Engineer, C. & N. W. Railway.
22. Mr. S. Simmons, Engineer, C. & N. W. Railway.
23. Mr. William Donahue, Traveling Engineer, C., St. P., M. & O. Railway.
24. Mr. W. A. Derby, Engineer of Tests, C., B. & Q. Railway.
25. An observer (Engineer of Tests), C., B. & Q. Railway.
26. Mr. E. W. Jansen, Electrical Engineer, I. C. Railway.
27. Mr. H. Christman.
28. Mr. J. F. Devine, Engineer, C., M. & St. P. Railway.
29. Mr. L. P. Jerrard, Civil Engineer Inspector, Railway Commission.
30. Mr. R. M. Feustel, Office Engineer, Railway Commission.

In the "standing" tests, an arbitrary distance of 30 feet was deducted from observed distances when the C. & N. W. locomotives were used, and 20 feet was deducted when the smaller C., M. & St. P. locomotives were used. This was done because the zero point was opposite the cab of the engine, while the larger portion of the observers were at the front of the engine Observations by persons in the cab, therefore, are for distances 20 feet or 30 feet greater than those recorded in the tables.

The wording given in the tables of each man's observations is not always exactly as recorded by the observer, but has been

18-inch "Commercial" Acetylene.
Observation, June 15, 1912.
Engine No. 840, C. M. & St. P. Ry.
Weather: dark and clear.

TABLE XXXII

RUNNING TEST

Object:—One man in white suit standing in center of track at station 25+00

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT			
		W 11 1500	W 12 1420	W 13 1390	W 14 1350
5	Cab	X	Indistinct white object	Same	Same
8	Right gangway of cab	X	X	Shadow	—
9	Step, right side of pilot	X	Light spot between rails	Light vertical object between rails	Same
12	—	X	X	Object on track	Light object
13	Pilot	X	X	Object on track	Person on the track
14	Driving engine	Light object on track	Same	Man standing	Same
16	Cab, left	X	X	White	Same
17	—	X	X	White	Same

X Indicates "nothing visible"
— Indicates "no observation made"

18-inch "Commercial" Acetylene.
Observations, June 15, 1912.
Engine No. 840, C. M. & St. P. Ry.
Weather:—Dark and Clear.

TABLE XXXIII

RUNNING TEST

Object:—One man in gray suit standing in center of track at station 11+00.

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT			
		W 21 580 Feet	W 22 440 Feet	W 23 360 Feet	W 24 290 Feet
5	Cab	Indistinct—gray	Same	Gray person	Same
8	Right gangway of cab	Shadow, seen 5 seconds before whistle	Faint object	Tall object	Man
9	Step—right side of pilot	Dark object between rails	Man in gray between rails	Same	Same
12	—	Object on track	Same	Person on track	Man in light clothes on track
13	Pilot	Object on track	Object standing	Person on track	Man in light clothes
14	Driving engine	*Gray object on track	Man on track walking	Man in center of track	
16	Cab—left	Gray	Same	Same	Same
17		Gray man	Same	Same	Same

X Indicates "nothing visible."
— Indicates "no observation made."
* Indicates "Engineer gave first signal."

18-inch "Bunn" Safety Headlight.
Observation, June 14, 1912.
Engine No. 1338 C. M. & St. P. Ry.
Weather: dark and overcast.

TABLE XXXVI

STANDING TEST

Object:—One man in black suit walking in track.

No. of Observer	Position of Observer	DISTANCE OF OBJECT-IN FRONT OF HEADLIGHT		
		P 21 260 Feet	P 22 190 Feet	P 23 90 Feet
2	Front of engine	Dark object on track	Dark man-face plain	Man—plain
5	Front of engine	Object on track	Dark dress white face	Dark person, white shirt and face
6	Front of engine	X	Dark object on track	Dark man on track
9	Front of engine	Dark object	Man in dark suit approaching between rails	Same
12	Front of engine	Object on track	Man on track	Man in dark clothes walking on track
13	Front of engine	Object on track	Man in dark clothes	Man walking on track
15	Driving engine	Light object	Same	Two men
16	Left side of cab	X	Black-1	Same
17	—	X	Dark-1	Same
27	—	X	Dark figure	Dark man

X Indicates "nothing visible."
— Indicates "no observation made."

18-inch Bunn Safety Headlight.
Observation, June 14, 1912.
Engine No. 1338, C. M. & St. P. Ry.
Weather: dark and overcast—may have been foggy.

TABLE XXXVII

RUNNING TEST

Object:—One man in white suit between rails at station 10+00. Speed of engine, equal to 8 M. P. H.

No. of Observer	Position of Observer	DISTANCES OF OBJECT IN FRONT OF HEADLIGHT			
		Q 1 650 Feet	Q 2 550 Feet	Q 3 490 Feet	Q 4 425 Feet
2	Left side of pilot	Faint light object on track	Fairly plain white object size of man on track	Plain white dressed man in track	Same
5	Pilot	Indistinct white object	White object	White person	Same
9	Right engine gangway	Object between rails	Vertical white object between rails	Man in white between rails	
12	Pilot	Object on track	Object like man on track	Man on track	Man in light clothes
13	Pilot	Object on track	Light object	Man on track	Man in white clothes
15	Running engine	X	White object	—	—
16	Left side of cab	X	White—1	Same	Same
17	—	X	White man	White man, plain	White man, very plain
27	—	X	White man	Same	Same, very plain

X Indicates "nothing visible."
— Indicates "no observation made."
Note:—May have been affected by fog which was noticed plainly during succeeding test.

altered slightly for the sake of brevity. The meaning is not changed, however, in any case.

Laboratory Tests.

On May 7th and 8th members of the staff made measurements of the illumination of the Bunn 18-in., Bunn 16-in. and some Standard oil headlights, and on June 17th of the 18-in. and of the 27-in. Commercial Acetylene lights. All these tests were made on the University grounds with a Sharp-Millar universal photometer.

The following table gives the results of all of these facts:

Illumination from Varions Headlights Measured in Foot-Candles.

Type of Light.	Foot-Candles measured at a distance given				
	100 ft.	200 ft.	300 ft.	400 ft.	500 ft.
Standard light, old	.14	.01	.02	...	..
Standard light, new	.15	.03	.02	.01	..
Bunn light, 16 in	.44	.04	.05	.025	.01
Bunn light, 18 in	.40	.10	.05	.03	.02
Acetylene light, 18 in	1.45	.54	.22	.11	.10
Acetylene light, 27 in	.74	.30	.18	.13	.08

All these results are shown platted on Chart 1.

It should be explained that the 27-in. reflector of the acetylene light was in very poor condition. From a position in front, the upper third appeared entirely dark. This was true to some extent during the road tests also.

A signal bridge extends across the three tracks of the Chicago & North Western Railway just south of the Chicago, Milwaukee & St. Paul Railway crossing over the two west tracks, the bridge carries lights and boards controlling northbound trains. The lights to be tested were on engines headed north on the third or east track. A course 2,500 feet long was measured off south of the signal bridge. The tests of the effect of the electric lights on signals were made by stopping every 500 feet, when each observer recorded just what was visible on the bridge over the two west tracks. Various combinations of the lights were made on the signal bridge, which were unknown to any of the observers.

It should be remarked that the first point of observation, 2,500 feet from the bridge was well around a curve, and, therefore, the headlights were not directed towards the signals from this point.

TABLE XLIX

Pyle National Electric Headlight.
Observation, June 11, 1912—11:30 p. m.
Weather: dark and clear.

EFFECT ON SIGNAL LIGHTS

No opposing headlight

Test headlight 1500 feet south of signal bridge.

No of Observer	Both signal lights extinguished				Both signal lights extinguished. White lantern placed under east signal lens.			
	L 51 Test HL Burning		L 52 Test HL Blanketed		L 53 Test HL Burning		L 54 Test HL Blanketed	
	West	East	West	East	West	East	West	East
1	W	W	X	X	W	Y-W	X	Y-W
2	Gd	W	X	X	G-Wd	2W	X	1W
5	Ref.	Ref.	X	X	Ref.	1W	X	1W
6	W	W	X	X	G	W	X	W
7	Gd	Gd	X	X	Wd	Wd	X	W
9	G	W	X	X	G	W	X	W
10	Lt	Lt.	X	X	Lt.	2 Lts.	X	1 Lt.
11	W	W	X	X	W	W	X	W
16	G	G	X	X	G	W	X	W
21	G	G	X	X	G	W	X	W
22	G	G	X	X	G	W	X	W

R =Red light.
W=White Light.
G =Green.
G-W =Green or White light.
Y =Yellow light.
Y-W=Yellow or white light.
X =Nothing.
Ref. =Reflection (no color given).
Lt. =Light (no color given).

TABLE L

American Electric Headlight.
Observation, June 10, 1912, 9:35 P.M.
Weather: Dark, threatening rain.

EFFECT ON SIGNAL LIGHTS

No opposing headlight

Object:—West { Light behind red lens / Blade horizontal.
East { Lamp taken out. / Blade horizontal.

No. of Observer	C 1—2500 Feet				C 2—2000 Feet				C 3—1500 Feet				C 4—1000 Feet				C 5—500 Feet			
	West		East		West		East		West		East		West		East		East		West	
	Light	Blade	Light	Blade	Light	Blade	Light	Blade	Light	Blade	Light	Blade	Light	Blade	Light	Blade	Light	Blade	Light	Blade
1	R	X	W	X	R	H	W	H	R	H	W	H	R	H	W	H	R	H	W	H
2	R	X	Wd	X	R	H	Wd	H	R	H	W	H	R	H	W	H	Ra	H	Wd	H
3	R	X	W	X	R	H	W	H	R	H	W-G	H	R	H	W-G	H	R	H	G	H
5	R	X	X	X	R	X	Wd	X	R	H	Wd	H	R	H	Wd	H	R	H	Wd	H
6	R	X	Gd	X	R	H	Gd	X	R	H	Gd	H	R	H	W	H	R	H	X	H
9	R	X	W	X	R	X	W	X	R	H	W	H	R	H	W	H	R	H	X	H
10	R	X	W	X	R	H	W	H	R	H	W	H	R	H	W	H	R	H	Wd	H
11	R	X	Wd	X	R	X	Wd	X	R	Hd	W	Hd	R	H	Gd	H	R	H	Wd	H
16	R	X	G	X	R	X	G	X	R	H	G	H	R	H	G	H	R	H	G	H
18	R	X	G	X	R	X	G	X	R	X	G	X	R	H	G	H	R	H	G	H
19	R	X	G	X	R	X	G	X	R	X	G	H	R	H	G	H	R	H	G	H
20	R	X	G	X	R	X	G	—	R	H	Gd	H	R	H	Gd	H	R	H	G	H
21	R	X	G	X	R	X	G	H	R	H	G	H	R	H	G	H	R	H	G	H
22	R	X	G	X	R	X	G	X	R	H	G	H	R	H	G	H	R	H	G	H
23	R	X	G	X	R	X	G	X	R	H	G	H	R	H	G	H	R	H	X	H
24	R	X	G	X	R	X	G	X	R	H	G	H	R	H	G	H	R	H	G	H
25	R	X	L—G	X	R	X	L-G	X	R	H	L-G	H	R	H	L-G	H	R	H	L-G	H
26	R	X	G	X	R	X	G	X	R	H	G	H	R	H	G	H	R	H	G	H
29	R	X	Wd	X	R	H	Wd	H	R	H	Wd	H	R	H	Wd	H	R	H	X	H
30	R	X	Sp	X	R	X	Sp	X	R	H	Sp	H	R	H	Sp	H	R	H	Sp	H

R = Red Light.
W = White Light.
G = Green Light,
W-G = White or Green Light.
X = Nothing Seen.
L.G = Light Green Light.
H = Horizontal.
D = Inclined.
d = Dim or Faint.
a = Also Dim Green Light Below and to Right of the Red.
Sp = Small White Speck.

TABLE LIV

18-inch Bunn "Safety" Headlight.
Observation, June 14, 1912.
Weather: dark and clear.

EFFECT ON SIGNAL LIGHTS

Test headlight 500 feet south of signal bridge

No. of Observer	O 1		O 2		O 3		O 4		O 5	
	Lamps removed. No opposing headlight.		West lamp removed. East lamp extinguished but in place. No opposing headlight.		Lights same as O2. 18-inch Bunn headlight opposing.		Both lights showing through red glass. 18-inch Bunn headlight opposing.		West light showing through red. East light showing through green. 18-inch Bunn headlight opposing.	
	West	East	West	East	West	East	West	East	West	East
1	X	X	X	X	X	X	R	R	R	G
2	X	X	X	X	X	X	R	R	R	G
5	X	X	X	X	X	X	R	R	R	G
6	X	X	X	X	X	X	R	R	R	G
9	X	X	X	X	X	X	R	R	R	G
12	X	X	X	X	X	X	R	R	R	G
13	X	X	X	X	X	X	R	R	R	G
16	—	—	X	X	X	X	R	R	R	G
17	X	X	X	X	X	X	R	R	R	G
27	X	X	X	X	X	X	R	R	R	G
28	X	X	X	X	X	X	R	R	R	G

R Indicates Red Light.
G Indicates Green Light.
X Indicates No Light.

18-inch "Commercial" Acetylene.
Observations, June 14, 1912.
Weather: Very heavy fog.

TABLE LV

EFFECT ON SIGNAL LIGHTS

Test headlight 500 feet south of signal bridge

No. of Observer	R—1 West lamp removed East lamp in place but extinguished White light hung over west signal No opposing headlight		R—2 Both lights showing through red glass No opposing headlight		R—3 Lights same as R—2 18-inch Acetylene 40-feet N. of bridge opposing		R—4 West light showing through red East light showing through green Opposing headlight same as R—3		R—5 Lights same as R—4 Same opposing headlight 100-feet So. of bridge		R—6 Both lights showing through red glass Opposing headlight same as R—5	
	West	East	West	East	West	East	West	East	West	East	West	East
2	W	X	R	R	R	R	R	G	R	G	R	R
5	—	—	R	R	Rd	Rd	Rd	Gd	Rd	Gd	Rd	Rd
6	W*	X	R	Rd	R	R	R	G	Rd	Gd	R	R
9	W (a)	X (a)	R (a)	Rd (a)	R	R	R	Gd	Rd	Gd	Gd	Gd
12	W	X	R	R	R	R	R	G	R	G	R	R
13	W	X	R	R	R	R	R	G	R	G	R	R
16	W	X	R	R	R	R	R	G	R	G	R	R
17	W	X	R	R	R	R	R	G	R	G	R	R
27	W	X	R	R	R	R	R	G	R	G	R	R

R=Red light X=No light
W=White light d=Dim or faint
G=Green light
* This light appears somewhat lower than regular signal. (a) R-1 and R—2=Not observed at proper time.

During the test of the American Electric, the blades as well as the lights were observed, but for the remainder of the tests only lights were observed.

During the evening of August 21, 1912, some tests were made for the purpose of observing what effect the electric headlight might have upon switch lights. Observations were also taken of the signal lights on the signal bridge of the C. & N. W. Railway at the crossing with the C., M. & St. P. Railway just south of Madison which have been described above.

At the request of the commission, the C. & N. W. Railway Company very promptly equipped an engine with an electric headlight and supplied a train crew for its operation. Permission was also given for use of the southbound main track and for the manipulation of the signals as necessary. Two switch lamps were erected on temporary stands, one either side of the track upon which the test engine was operating. These switch lamps were placed directly under the signal bridge.

The observation of lights on the signal bridge were to some extent a repetition of those made on June 11th; the course was the same and readings were made in the same manner.

During these tests, the train was stopped every 500 feet, beginning 2,500 feet south of the signal bridge, and observations were recorded by each observer as to just what was seen at the location of each of the four lights, that is two on the signal bridge and the two switch lamps placed under the bridge. In no case did the observers know beforehand what arrangement of lights to expect.

Following is a list of the observers during the test:

1. Mr. C. F. Harding, Professor Electrical Engineering, Purdue University.
2. Mr. J. R. Ong, Assistant Engineer, R. R. Commission.
3. Mr. J. R. Ong, Assistant Engineer, R. R. Commission.
4. Mr. J. H. Wasson, Engineering Computer, R. R. Commission.
5. Mr. O. G. Burritt, Engineering Inspector, R. R. Commission.
6. Mr. R. H. Morrison, Engineer of Tests, C., M. & St. P. Ry.
7. Mr. C. S. Wilber, Locomotive Engineer, C., M. & St. P. Ry.
8. Mr. A. S. Merz, Locomotive Engineer, C., M. & St. P. Ry.
9. Mr. Frank Zeleny, Engineer of Tests, C., B. & Q. Ry.
10. Mr. L. R. Pyle, M., St. P. & S. S. M. Ry.
11. Mr. A. Burch, Locomotive Engineer, M., St. P. & S. S. M. Ry.
12. Mr. E. R. Gorman, Traveling Engineer, C., St. P., M. & O. Ry.
13. Mr. W. E. Dunham, Super. M. P. & M., C. & N. W. Ry.
14. Mr. M. Comford, Locomotive Engineer, C. & N. W. Ry.
15. Mr. A. M. Ross, Roundhouse Foreman, C. & N. W. Ry.
16. Mr. F. R. Melcher, R. H. Foreman & Engineer, C. & N. W. Ry.
17. Mr. E. L. Gingrase, Locomotive Engineer, C. & N. W. Ry.
18. Mr. M. Nevins, Locomotive Engineer, C. & N. W. Ry.
19. An observer, Locomotive Engineer, C. & N. W. Ry.
20. An observer, Locomotive Engineer, C. & N. W. Ry.
21. An observer, Locomotive Engineer, C. & N. W. Ry.
22. Mr. S. Simmons, Locomotive Engineer, C. & N. W. Ry.

It should be stated that in the opinion of the writer, who was present at this test as well as at the tests previously made, the headlight on this night, August 21st, either was less efficient than upon the occasion of the test during June or it was so adjusted that the rays of light were directed below the lights on the signal bridge. The request was made that the headlight be so adjusted that the rays of light would be thrown far down the tracks as they were while tests were being made for the purpose of detecting obstructions on the track at the greatest possible distance. The necessary changes were made (at test CC3) and a decided increase in the amount of reflected light from roundels was apparent. However, within a very short time, the rays of light were again directed so low as to be below the lights on the signal bridge, though no readjustment was made to bring about this last mentioned condition. Furthermore, while the writer found it impossible from any great distance to distinguish classification lights placed near the electric headlight during the June tests, he was able to distinguish them very well for great distances during the test of August 21, 1912, which strengthens the belief that the electric light on this last occasion was less powerful than that employed during June. No attempt was made, however, to determine the voltage or current delivered to the light or to determine the speed of the turbine.

Comments on the Obstacle Tests.

The writer will not at this time attempt to draw any conclusions as to which of the lights tested may be considered as complying with the law. This is a matter upon which the railroad commission will undoubtedly express an opinion in due time, but attention should be directed to some points.

The law states that the headlight shall be "of sufficient candlepower, measured with a reflector, to throw a light in clear weather that will enable the operator * * * to plainly discern an object the size of a man, at a distance of not less than eight hundred feet." Now it is plain to all who observed the obstacle tests above described that the first observations were invariably made as soon as the object first became visible to the slightest extent, and in general it was some time thereafter before the object was "plainly" discernable. The observations recorded in the tables also make this plain.

Another point to which attention is called is that all observers were almost certain that some kind of an object would be seen somewhere along the measured course and within a short time after the test was started, and no doubt this fact also tended to assist the observers in discerning the object earlier than would

have been done had the objects been seen during the regular operation of a train.

However, all conditions were made as nearly similar to regular operating conditions as it was possible to get them in a test. In order that the observers might not report before the objects were actually seen, they were warned that it was the intention of those in charge to run several tests without any object at all, and in fact this was done in two or three instances.

Inspection of the tables will also reveal the fact that persons located on the pilot or near the front of the engine were able to detect the object considerably earlier than persons in the cab. In one series of "running" tests, however, the man driving the engine was the first to detect the object in every run.

Chart II shows in a general way comparative results of the obstacle tests, each line, representing the distance the objects were visible, is necessarily an average of several tests, and each test was observed by many observers. The chart, therefore, simply represents the writer's judgment in the matter. Moreover, it was not necessarily the greatest distance that was taken, but that distance at which a majority of the observers appeared to see the object with some degree of distinctness.

Comments on Signal Tests.

A close scrutiny of the tables reveals such a large percentage of so-called phantom lights recorded by all observers, that it is necessary to go beyond the tests for explanations as to why there are not more accidents resulting.

In one case with a Pyle National test light and no opposing headlight, with No. 1 semaphore light extinguished and the blade horizontal, out of a total of 60 observations by 20 observers at 2,000, 1,500 and 1,000 feet, 48 or 80 per cent saw a white or green light. At 2,500 feet and 500 feet few saw any lights. With No. 2 semaphore light out and blade inclined, out of a total of 60 observations by 20 observers at 2,000, 1,500 and 1,000 feet, but 8 or 13 per cent saw any light and only one saw a light at 2,500 feet and none at 500 feet.

In one case, though the lights were out in both switch lamps with one green and one red lens towards the observers, the green was not seen at all while 10 out of the 20 detected the red at 1,000 feet, and all saw it at 500 feet. In another test with a Pyle National test light, no opposing headlight, there resulted what is, in some respects the most interesting of all the signal tests, as phantom lights were seen while a red light burned in the semaphore. With the No. 1 semaphore light extinguished and the blade horizontal, out of a total of 60 observations at 2,000, 1,500 and 1,000 feet by 20 observers, 56 show either a white, green or orange light and three show a red light. When the headlight was blanketed at 1,000 feet one only reports having seen a dim light. With the No. 2 light actually burning red, out of a total of 56 observers at 2,000, 1,500 and 1,000 feet by 20 observers, 49 or 87 per cent show either a white, yellow, green or orange light, while 7 show a red light. When the headlight was blanketed at 1,000 feet, practically all record having seen the red light.

Switch Lights. One feature in connection with the observations taken on the switch lights is that when they were lighted they were almost always read correctly, and when the lights were extinguished the observers saw the red usually at 1,000 feet and almost always at 500 feet while the green was seldom seen. In no case was an error made in reading the correct color of the switch lights.

Semaphore Blades. During the test on the American Electric, observations were made on blades as well as on lights, and in Table 50 with no opposing headlight none were seen at 2,500 feet, 30 per cent saw them at 2,000 feet and practically all saw them at the remaining stations. In Table 51 with no opposing headlight, nobody saw the blades at 2,500 feet, 25 per cent saw them at 2,000 feet and nearly all saw them at the remaining stations. In Table 52 with a Pyle National opposing, nobody saw any blades at 2,500 or 2,000 feet; 50 per cent saw them at 1,500 feet and at 1,000 feet, and all saw them at 500 feet. In Table 53 with the same opposing headlight, nobody saw the blades at 2,500, or at 2,000 feet, and only 5 per cent saw them at 1,500 feet; at 1,000 feet 30 per cent saw the blades while at 500 feet 80 per cent saw them.

From the above it will be seen that the blades are very much harder to detect with a headlight opposing than where there is no headlight directed against the observers. It should be stated also that while the blades were visible still they were not plainly seen at any time while an electric headlight was opposing.

It will be noted further that only a small proportion were able to see the blades at 2,000 feet, showing that the engine was somewhere between 1,500 and 2,000 feet from the bridge before the blades became generally visible.

Classification Lights. Attention is called to the fact that out of 182 observations made by 13 observers standing on the track 600 feet in front of the Pyle headlight, while various colors of white, red or green lights were exposed where classification lights are carried, not one light was seen in the entire 182 observations.

The same test repeated with the observers about 100 feet in front of the engine resulted in 149 out of the 182, or about 82 per cent, being read correctly.

It should be stated that the effect of standing for a considerable period of time and looking into the strong headlight was exceedingly trying on the eyes and many have been, to some extent, the cause of such a poor showing.

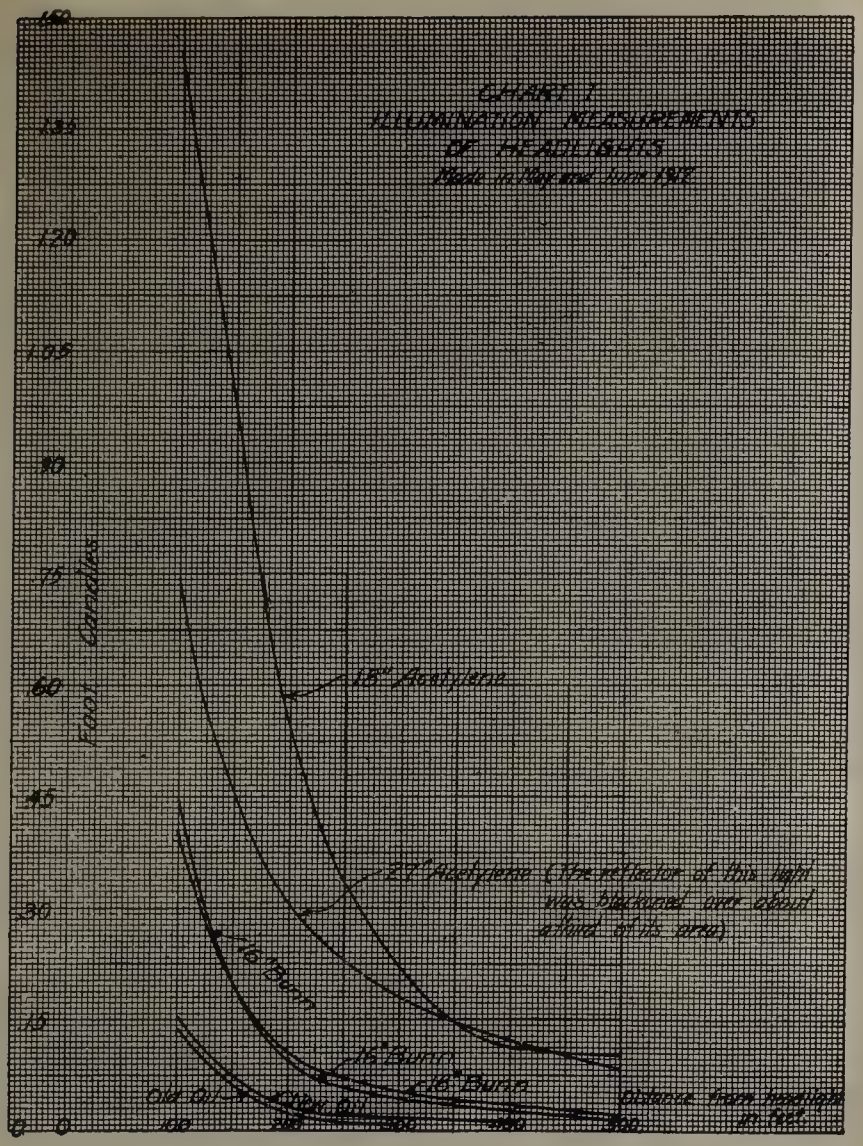
The 1910 annual report of the Interstate Commerce Commission summarizes the situation up to that date in the following language:

"*Headlights.* During the past year considerable discussion has taken place in regard to the use of locomotive headlights of high candle-power. In seven states, Arkansas, Montana, North Carolina, Oklahoma, South Dakota, Texas and Washington, locomotive headlights of 1,500 candle-power or over are required by law; in Indiana locomotive headlights of 1,500 candle-power or over are required by an order of the state railroad commission, and in Georgia the law requires electric headlights with 300 watts at arc and reflectors 23 inches in diameter.

"The ordinary oil headlight commonly employed on locomotives is seldom powerful enough or maintained in a condition to make it more than a marker to indicate to persons at stations or railway crossings, or in yards or to trains on other tracks, that an engine is approaching. As a means of discovering or identifying distant objects on the track it has practically no value. The argument in favor of the high-power headlight is that persons or obstructions on the track may be seen by the light of a powerful gas or electric headlight at a sufficient distance to enable the train to be stopped before reaching them. On straight track the high-power headlight undoubtedly affords a degree of illumination, except in snow or fog, sufficient to enable an experienced engineman to distinguish unusual objects on the track at a considerable distance.

"As headlights are usually fixed in position, their rays are projected in the direction of the axis of the locomotive, and hence on curves do not illuminate the track ahead. Various devices have been submitted to the board intended to impart to the headlight while the engine is rounding a curve motion to turn its beam so that it will fall on the track. Most of these devices are crude, and attempt to use the curving of the front truck of the locomotive as it passes around curved track, to rotate the headlight. It seems unlikely that any apparatus of this kind can be made effective to meet all the conditions of reversed curves, tangents succeeding curves, and variations in curvature, that are found on many railroads, and it is probable that if full advantage is to be taken of this high illuminating power of gas or electric headlights on roads where much curvature exists, any motion of the headlight about its vertical axis must be within the control of the engineman.

"Very strong objections are made to the use of high-power headlights, for the reason that the rays are so intense as to im-



pair seriously for several seconds the vision of persons who may look into the beam. This effect, when experienced by enginemen of trains running in the opposite direction on parallel tracks, is considered by many to be serious. It has long been known that after a locomotive fireman has looked into the fire box for ever a very few seconds in putting on coal the scotoma which persists for some seconds afterwards makes his reading of signals at night very unreliable until its effect has had time to pass off. As regards the effect of the high-power beam upon the vision of the men riding on the engine on which the electric headlight is used, it has been found in some rather extensive tests that the rays were sufficiently powerful to reflect back from the surfaces of the roundels of semaphore signals an amount of light sufficient to overpower the light transmitted by the signal lamps themselves. The spectrum of the electric arc is very rich in blue and green rays and contains a relatively small proportion of the red and yellow; hence rays from the arc light reflected from the surface of the colored roundel would tend to diminish the resultant proportion of red in the light, and if reflected back from a green roundel would intensify its color. Very deceptive effects of this kind have been noticed by many observers, and while apparently such conditions may be dangerous as leading to erroneous reading of a signal light, they are largely counteracted by the fact that the high power of the light serves to reveal at a considerable distance the position of the signal arm. The usual rules governing enginemen in their interpretation of signal indications state that the indications will be displayed by day by positions of the semaphore arm, and in addition at night by lights of prescribed color, the effort being made to train the enginemen in so far as possible to depend upon position rather than upon color.

"In the case of classification signals—that is, the colored lamps used on the front end of engines to indicate whether the train is an extra rather than a regular train, or whether it is running in two or more sections—the condition is much more liable to cause a misunderstanding of signals for the reason that classification signals are color signals purely, and are not signals of position. So difficult is it to read classification signals correctly when viewed in the beam of an electric headlight that railroads have made strenuous objection to their use on this account alone.

"The whole question at the present time is in a highly controversial state. So far as opinion has at all crystallized it appears to be as follows:

"On single track roads, particularly those in mountainous country or where fixed signals are infrequent, the high-power headlight on a train affords a warning of its approach for a considerable distance, and under favorable circumstances it enables the engineman to distinguish obstructions or unusual objects on the track much farther ahead than is possible with ordinary lights.

"On double track roads, and particularly on roads having three or four tracks and equipped with signals placed at frequent intervals the prevailing opinion seems to be that the electric headlight is not only unnecessary, but is likely to cause serious errors on the part of the enginemen in reading color signal lights."

A series of tests made early in 1909 by Mr. J. W. Chamberlain, Opthalmic Surgeon of the Great Northern Railway, attacks the problem from a somewhat different angle and is quoted here, the report being in shape of a letter to Assistant General Manager H. A. Kennedy, dated February 23, 1909. It follows:

"I beg to submit herewith the report of a series of experiments intended to demonstrate the effect, if any, that would be produced on the eyes of enginemen, by the use of powerful electric headlights.

"The question is one which should be carefully considered, as it may effect the vision and thereby the usefulness of a large number of enginemen throughout the country. In making the experiments, I endeavored to reproduce, as far as possible, the exact condition under which a locomotive engineer and fireman would be situated in actual service.

"I took three men whom I had previously examined and found their vision to be perfect in every particular. They were placed in a darkened room, with an electric headlight at about the same distance in front of them that a headlight is in front of the cab on an engine. The men were directed to look steadily ahead into the area illuminated by the electric light and at intervals of three-quarters of an hour, a headlight was operated from the opposite direction, to represent another train, as it would appear, if passing on a parallel track.

"After a while, colored lights, representing those in use for railway signals were exposed as they would be seen from a locomotive coming into a station or yards. These lights were exposed one at a time.

"The colors used were Red, Green, Blue and Yellow. These lights were exposed singly at intervals, without rotation so that the men being examined would not know in advance, what light was to be exposed. It was demonstrated that after a lapse of two hours, the colors that were exposed within the field illuminated by the headlight were so diffused as to make it utterly impossible for any of us to tell what the colors were. For instance, an intense red would have the appearance of a light yellow, yellow would have the appearance of grayish white, while green and blue could not be distinguished from each other, but had the appearance of being gray or grayish white.

"At the end of three hours, four of the six observers called red, yellow; while two called it white.

"There were many exposures made and the experiment was tried numberless times, with no change in the results.

"I was assisted in making these experiments by Mr. Tolz, Consulting Engineer, Mr. Durham, Signal Engineer, Mr. Yoerg, Mechanical Engineer, and Mr. Heron, Superintendent of the Shops, who were all stationed where they could witness the experiments and give their opinion as to which colored

light was being exposed and they were unanimously agreed that after looking into the field illuminated by the electric headlight for two hours, it became impossible to determine the colors seen in ordinary switch and signal lamps at a distance of 2,400 feet."

In a letter dated June 11, 1909, to General Superintendent Bryan of the Great Northern Railway, Mr. C. E. Leverich, Superintendent, gives the following explanation of the cause of a train delay at Minot:

"Replying to your letter of June 5th in regard to delay to extra 1837 at Minot, by reason of glare of headlight on train Number One, standing at the passenger station.

"I attach hereto blue print as asked for and have shown thereon the place where Number One's engine stood, also the place where engine 1837, the extra east, stood. Engineer on extra 1837 advises that when approaching the Soo Line Crossing, he called for the passing track, but on account of the outgoing engine standing on passing track with electric headlight burning, he could not see whether or not semaphore or home signal was clear, consequently stopped his train. All this time Number One had not yet shown up and the engineer on the 1837 thought that possibly the outgoing engine would back up into siding near the service building and let him by. A few minutes after that Number One arrived and the change of engine was made, in the usual manner. Engineer Hein on the 1837, after the change was made, again called for the passing track but he could not see whether he got it or not as the electric headlight on Number One's engine blinded him to such an extent that he could not see the semaphore signal. He sent the brakeman down to tell Number One's engineer to put out the light; before the brakeman reached the depot, however, Engineer West on Number One thought possible that the trouble was on account of Engineer Hein not being able to see the signal on account of his headlight, and he put it out, after which extra 1837 pulled into clear."

The L. & N. Railway made extensive investigations of headlights in 1909 and 1910, and many other reports on the same subject are to be found. All agree in a general way as to phantom lights.

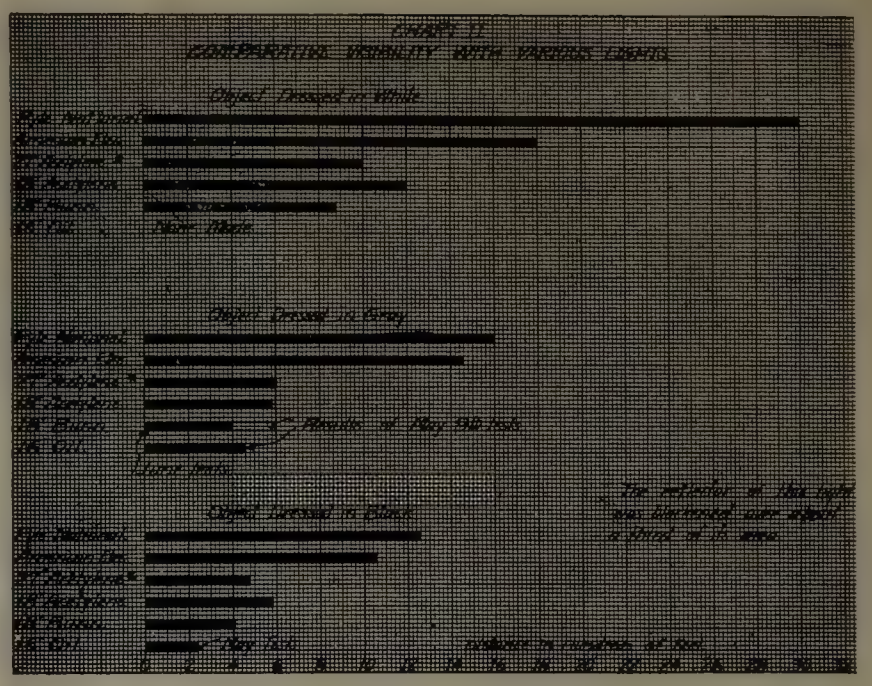
Electric Headlights in Operation.

It is a well known fact that the high power electric headlight is being used in the operation of trains on many railroads, and apparently with success. In an attempt to obtain an explanation of the apparent incongruity, the writer has recently interviewed a good many railroad men, including many locomotive engineers. The general opinion of practically all the locomotive engineers interviewed who have actually used the electric headlight, is that if there are any dangers due to their high power, these are more than overcome by the many good points in favor of this light.

At a conference of locomotive engineers called by the Wisconsin Railroad Commission on September 12, 1912, a very thorough discussion took place between those favoring the electric headlight and those opposing same. In general those who have driven an engine carrying the electric headlight admit that it is difficult to distinguish classification lights and to determine the number of the engine in meeting trains. In recognition of this, one large system has devised a method of displaying the engine number at a point nearer the cab, and it is probable that colors could be handled in the same way. It is claimed that this is satisfactory.

The engineers claim to be able to distinguish the blades of semaphores and to be governed accordingly, and though they admit seeing flashes of lights at times, they are able to recognize them and do not become confused.

However, some of the locomotive engineers who were present at the tests state that the phantom lights which they called green were just as bright as are often found with the poorer shades of acceptable roundels. Others say that the lights were



the shade of green that might be seen when the lamp in the signal was turned rather low.

They also learn how to protect themselves from the rays of an approaching headlight. They admit difficulty with flagmen and yardmen between two engines approaching each other, both carrying electric headlights. They believe that this can be handled in a satisfactory manner by turning off the arc and throwing in the incandescent light. This is also done when a train carrying colors meets another, and at other times when, in the opinion of the engineer, his light is likely to inconvenience the driver of the approaching engine.

Interviews of others in railroad business resulted in a great divergence of opinion ranging from the belief that electric headlights are the very best that can be devised to the belief that electric headlights represent the very poorest in railroad practice.

Conclusion.

Special attention is directed to the fact that in all the tests conducted in Wisconsin a majority of the observers were men in regular service of the railroads and for the most part they are locomotive engineers. This fact largely removes the objections usually urged against such tests that they are not made by practical men. Furthermore the tables show that their observations were almost the same in all respects as those made by other than railroad men.

It would appear from the data collected during the signal tests that the use of high power electric headlights is attended with grave dangers, especially when there are two or more running tracks or where many signal lights are necessary, as in block signals and interlocking plants. These dangers exist, largely because of the liability of a light to become extinguished and because of the danger of an engineer being unable to see colors displayed on another engine.

The device of turning off the electric and turning on the incandescent at critical points cannot be relied upon entirely because of the inability of one engineer to know when his light may interfere with the operator of another train, and also he himself may be busy at the critical time and be ignorant of the situation.

On the other hand, no doubt, many accidents have been averted by the use of the high power lights, and it is well known that they are being operated every day on many good railroads. It is the belief of the writer that while the tests made have been exhaustive as regards the particular phases of the subject with which they dealt and have high value as pointing out dangers that cannot be ignored, still they represent only a few out of many things that it is necessary to consider before an opinion may be expressed with any degree of certainty. It is believed that the operator soon learns to

distinguish various effects of his light and depends upon being able to see the position of the blade at critical points where a phantom light might be misleading. It is felt, however, that even this practice has many elements of danger, as any signal which tends to confuse or mislead must be so considered.

It is believed that there are several features of high power headlights that have not received attention in these tests. For example yardmen and flagmen who are compelled to face these lights are often placed in dangerous situations over which they have no control. With two of these lights facing each other a flagman between has small opportunity of protecting himself and the operators of the engines find difficulty in recognizing any signal he may try to give.

It appears to be a conceded fact that it is almost impossible to estimate the distance away of an approaching engine carrying an electric headlight. This results in increasing the dangers to persons whose business requires them to be on the tracks near train time, and also creates dangerous situations at highway grade crossings.

In view of the many sides of the question and of the divergence of opinions expressed by railroad men and having in mind the report on good authority that several very important railroads has discontinued the use of high power headlights purely because of alleged increase in dangers of operation, the writer confesses his inability, at this time, to make any positive statement which might be in the nature of a conclusion. It is probable that conditions of operation vary so widely with different lines that equipment suitable for one road might be entirely unsuitable for another, and it is believed that this is the case in the state of Wisconsin.

It is the belief of the writer that there are headlights that have satisfactory illuminating capacity, and still are not of a kind whose rays have such a glare as do those of the arc light. Besides those now in use, several kinds of lights are now being developed which give good promise and it is to be regretted that more of them were not on the market while these tests were being conducted.

CAR FOREMEN'S MEETING.

The annual election of officers for the Car Foremen's Association of Chicago was held at the Karpen building on October 14, and resulted as follows: President, F. C. Schultz, chief interchange inspector; first vice-president, J. W. Senger, master car builder, Lake Shore & Michigan Southern Ry.; second vice-president, Geo. F. Laughlin, general superintendent Armour Car Lines; secretary, Aaron Kline, 841 No. 50th Court; treasurer, M. F. Covert, assistant master car builder, Swift's Refrigerator Transportation Co.

The short business meeting was followed by a banquet and a dance, which was participated in by the members and their families to the number of five hundred. Beautiful souvenirs were presented to the ladies and it was pronounced the best annual entertainment ever given by the association.

RAILWAY BUILDERS still continue to have their troubles. Previous to the construction of the Arica-La Paz Railway in Bolivia, South America, the contractors found that they would have to figure in water at about $3 per pail, as it was brought down from the mountain every morning on mules. This might have been a fair price for champagne by the quart but was pretty high for water. So before any work could be done on railway construction, it became necessary to construct a 75-mile pipe line from the mountains, costing $3,000,000. The final cost of this 267-mile railway was twelve and a quarter million dollars.

VACUUM CLEANING ON RAILWAYS.*

By H. Jacobi, Berlin.

It is well known that dust exercises a very bad influence on one's state of health. The dust which collects in railway cars is particularly objectionable from this point of view.

A great part of the dust is not removed if such methods of cleaning as beating, brushing and sweeping are adopted; it is only moved from one point to another. Moreover, these methods are expensive and injurious to many articles.

Cleaning by means of air under reduced or increased pressure was introduced in America and England about ten years ago; in particular there is the vacuum-cleaner process for removing the dust in houses. Such installations are now to be found, here in Germany also, in every well-equipped modern dwelling.

A sucker, closely fitting, is moved forwards and backwards over the surface which has to be cleaned; this mouthpiece is connected by a flexible tube with the suction pipe of an air-pump. The suction is varied to suit the article which is to be cleaned. The air removed carries away the dust deposited in the cushions or materials, and this dust is removed from the air by filtration on its way to the pump. The filtered air from the pump then escapes into the outer air.

Fig. 2.

About six years ago, the administrations of the Prussian-Hessian State Railway decided to investigate this cleaning process and to make experiments. A vacuum-cleaner plant was installed for this purpose and it was found that the dust-containing parts of passenger cars could be properly cleaned, if the carriage were close to the machines; but the cleaning became less satisfactory if the length of the pipe or tube line leading to the machines was increased. The cleaning was found unsatisfactory when the pipe line was only 656 feet in length. It was also found that when a number of suckers corresponding to the power of the air-pump were connected up at one and the same time, these mutually affected each other and air only entered the suckers nearest the air-pump.

Apart from this the cleaning of the curtains, mats, floors, walls, ceilings, parcel nets, corners and angles, especially underneath the heating appliances, was very troublesome

*Bulletin International Railway Congress.

and took much time, or was even impossible, because vacuum cleaning was not suitable for the purpose.

All these reasons prevented the vacuum cleaner process from giving satisfactory results.

Hence the process introduced by A. Borsig of Tegel, Berlin, was a welcome innovation. In it compressed air and reduced pressure are used simultaneously, and effective cleaning is possible, even in the case of very dirty carpets, thick cushions, etc. Air under pressure for blowing through the articles to be cleaned was formerly used by cleaning firms. This process was, however, not dust-free, as the dust disturbed passed into the outer air; hence this process was out of the question for enclosed spaces, such as railway carriage compartments. With the new process the disturbed dust does not escape, but is drawn into the vacuum and prevented from doing any harm.

The first installation of this kind was put up by the Prussian-Hessian State Railway at Cologne station.

The results there obtained soon led to the extension of this installation and to other installations elsewhere. At nearly all important stations in Germany where trains are made up, the Borsig system of cleaning cars is now used; for instance, at Cologne, Berlin (Silesia and Anhalt stations), Grunewald, Kattowitz, Danzig, Frankfort-on-the-Main, Hanover, Magdeburg, Breslau, Halle, Koenigsburg, Bremen, Hamburg, Basle (Baden station), Metz, Triers, Homburg, Cottbus, Mayence, Eydtkuhnen, Salbke, Strassburg (Alsace), Bischheim, Erfurt, Weimar, Wiesbaden, Brunswick, and at many other places; then also at many places abroad, for instance, Naples, Warsaw, Vienna, Kiev. Large installations are at present under construction at St. Petersburg and Bukarest, and at Tientsin station of the Chinese State line from Tientsin to Pukow.

Description of the Apparatus.

The compressed air passes from the flexible hose to the pipe a (Fig. 1) and is led by the latter to a three-way cock b. Part passes through the pipe d and the fine openings e on to the material which is to be cleaned, which is below

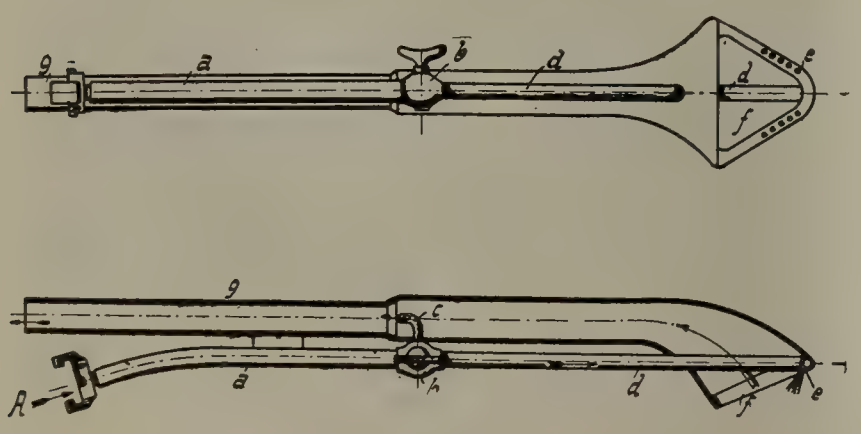


Fig. 1.—Cleaner Tool.

the mouthpiece f and there whirls up any dust present. The rest of the compressed air passes through the nozzle c into the exhaust pipe g, producing a vacuum in f, and so sucks in the whirled-up dust. By adjusting the three-way cock, this instrument may be made to act as a sucker only, or as a blower and sucker, or as a blower only. It is used for removing the dust from cushions, cloths and rugs. Figure 2 shows how it is used. Larger instruments with long handles are used for cleaning larger carpets.

The plant of the compressed-air dust-removing installation for cleaning dwellings and railway carriages includes an engine, a compressor, a delivery chamber and a compressed-air receiver, pipe lines, compressed-air hose with mouthpiece, hose for carrying away the dust, and filter for removing it.

As regards the appliances used for cleaning railway cars, the following require special mention.

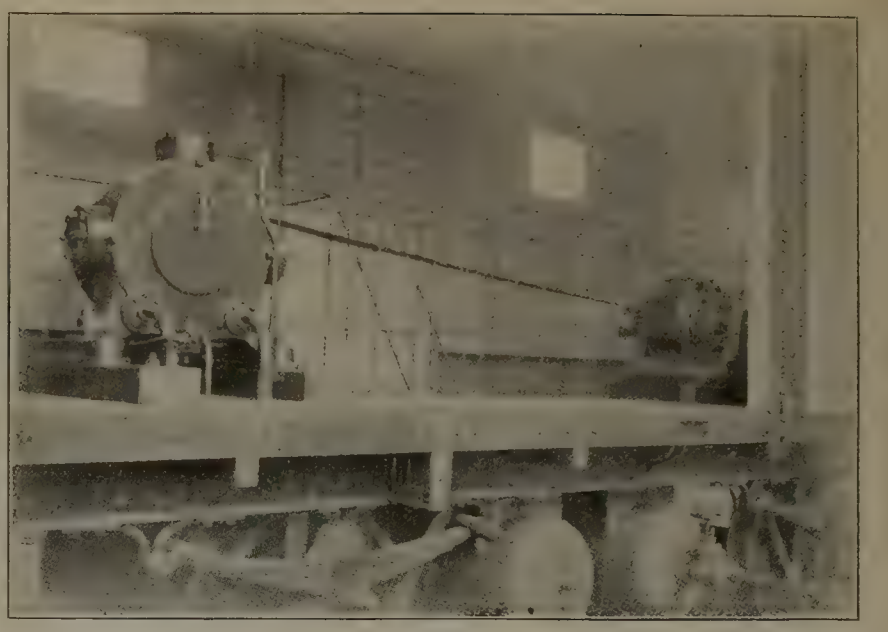


Figure 3.

The plant at Cologne (Fig. 3) was fitted up in a freight car, so that it could be shifted about and used at different places.

The frequent moving of this wagon, however, led to loss of time and also interfered with the shunting operations. It was therefore decided to have a stationary installation.

The engine, the pump and the receiver are placed together in a shed or old car body. As a rule, besides the small receiver next the pump, there is also a second large receiver or accumulator, in case of any sudden large demand for compressed air, for instance when making brake tests.

A pipe line runs from the receiver to the carriage cleaning sidings. The action of the compressed air installation is not affected by the nature and length of the pipe line. It is generally laid about 1 ft. 8 ins. below the level of the ground and cutout cocks and water-intercepting devices for getting rid of condensed water are added at suitable places.

Along the car-cleaning sidings, cocks are put up at intervals of about 98 feet. These cocks are protected by cast-iron casing or else secured to wooden posts, and flexible hose is used for connecting them with the cleaning tools.

The cleaning tools generally supplied to such an installation include: six cushion cleaners, two large carpet cleaners, four flat suckers for removing dust under the seats and behind the heating pipes, three plain suckers for cleaning mats, runners, some devices for blowing away dust from places which are otherwise inaccesible, such as corners and angles. Figure 5 shows a number of different cleaning tools.

The cleaning of wooden floors and of third and fourth class carriages is satisfactorily effected by opening the doors on both sides of the carriage and blowing out the dirt through the further door by means of compressed air issuing from a special tool having a long pipe. But the dust can also be sucked off the floors; there are special brushes used for this purpose.

Experiments have shown that compressed air quickly and thoroughly removes dust from textiles. The impact of the compressed air produces a kind of beating action. The action of the air jet is so strong, the amount of air it sucks is so great, that it not only removes the cloud of dust produced by the impact of the compressed air, but also sucks in considerable quantities of air through the material and from its immediate proximity. This sucking action taken alone removes the loose dust as well as a vacuum cleaner proper.

If vacuum cleaning only is to be used, the air jet producing the vacuum is not fitted in the tool, but fitted to the filter; this simplifies matters considerably. The compressed air pipe goes to the filter, and from this a short suction hose leads to the sucker. The compressed-air pipe has an internal

diameter of 5-8 to 15-32 inch only; hence, it is light and easy to handle.

A great advantage of using compressed air for removing the dust is that where compressed air is already available, as at railway workshops, this system of cleaning can be installed at low cost. Moreover, it is possible to clean the cushions, etc., at small stations where very few trains are made up and where consequently it seems inadvisable to put up a compressed-air plant, by using the brake pump of the locomotive. The compressed-air hose of the cleaning tool is then connected with the brake pipe of the train.

At stations where a greater number of trains is made up the compressed-air cleaning plant should be such a size that it can also supply the compressed air required for testing the brakes and for blowing out the smoke tubes and superheaters of the locomotives.

A simple filter consists of a number of cylindrical bags hanging down, having a sufficiently large total surface for the passage of the air. The material the sacks are made of is so closely woven that the air which escapes is perectly purified.

No particular care is required in emptying the filter. A patented shaking device makes it possible to shake the dust off the bags and to render them sufficiently clean.

The chief advantages of compressed-air cleaning are:

1. Thorough cleaning;
2. The action is not affected by the length of the pipe line;
3. It is possible to connect up a number of cleaning tools at any place desired, without any one tool having a bad influence on the action of any other tool;
4. No obstructions can be formed in the pipe lines, as these only carry compressed air;
5. The blowing action can be used at all places to which the suckers cannot obtain access. The work is done more quickly.

The pressure produced by the compressed-air plant is automatically regulated, and this reduces the cost materially. This no-load device is such that the air pump runs at no load as soon as the pressure in the receivers exceeds a certain figure, and again does work when the pressure falls below that figure.

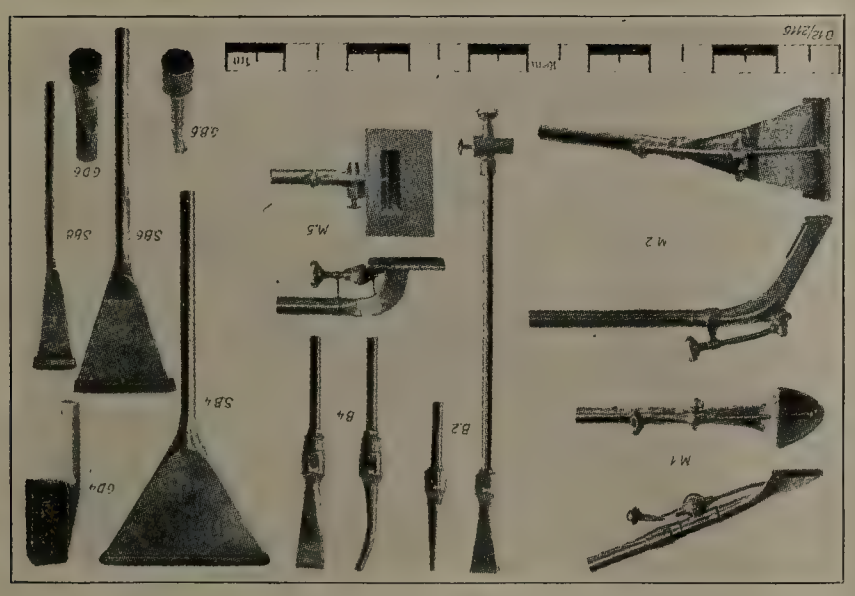


Figure 4.

Running at no load involves but a trifling loss. The device includes a pressure regulator and a valve controlling gear which can life the inlet valves of the compressor. The pressure regulator is placed either on the air receiver or on a support fixed to the air cylinder; in the latter case a pipe connects it with the air receiver. The pressure of the regulator spring is adjusted by means of a set screw and lock nut, so as to give the desired maximum pressure.

Still greater economy can be obtained in working if instead of such no-load running electric devices are provided which automatically start the electric motor and the compressor when the pressure in the receiver falls below 71 lb. per square inch and stop them when it rises above 99.5 lb. per square inch.

When the maximum pressure has been attained, an automatic switch cuts off the supply of current to the motor, which stops. It is again started, when the pressure has fallen to 5 atmospheres, by an automatic starter with magnet or with auxiliary motor. In this way the loss of power during no-load running is avoided.

The size of the cleaning plant is determined in accordance with the number of cars which have to be cleaned, with the times of day or night at which this has to be done, and with the eventual use of the compressed air for other purposes, such as brake tests, driving pneumatic tools, blowing out the smoke tubes of locomotives, etc.

There are plants which have pipe lines several kilometers in length, supplying compressed air to thirty tools simultaneously. Such large installations only make it necessary to raise the pressure in the receiver by a fraction of an atmosphere. It is an advantage to insert old locomotive boilers in long pipe lines, particularly if the air consumption is irregular, to act as extra air holders.

When the men are accustomed to the work and the appliances are used regularly, the seven compartments of a corridor carriage are cleaned in about forty-five minutes. When this air cleaning is first used for an old carriage, rather more time is at first required, owing to the accumulated dust, until the carriage is in as good condition as the rest.

The time required for the different methods of cleaning is per upholstered compartment:

By hand, forty to forty-five minutes, when in regular use;
Compressed air, twelve to fifteen minutes, when first used;
Compressed air, six to eight minutes, when in regular use.

The upholstered parts of a car need not be cleaned every day; the need varies with the nature of the country run through, the weather, the season and the number of kilometers run in a given definite time. In fixing it, it must also be taken into consideration whether the car is used to any extent by people suffering from contagious diseases, as for instance on the lines to Davos, to which many consumptives go.

Once the cars are properly cleaned, the cleaning lasts for a long time. For instance, 1.102 lb. of dust were removed by suction from the cushions of a car; after the car had again run 4,660 miles only 0.353 lb. were removed by suction. Other experiments gave 1.521 lb. the first time and, after a long interval, only 0.635 lb. the second time. The weight of dust sucked out of the cushions of a car has actually exceeded 3.30 lb.

THE PENNSYLVANIA RAILROAD has announced that orders have been issued restricting the maximum speed of all passenger trains under any circumstances at any point on the System East and West of Pittsburgh so as not to exceed seventy miles per hour. In addition, careful consideration has been given to the existing speed restrictions on curves. Thorough investigation of the conditions on each division of the Pennsylvania System developed the fact that the present schedules, with but few exceptions, will not be affected by the speed restrictions when trains are being operated on time. The new instructions will only become operative when time has been lost at terminals or on the road, and will then prevent a speed of above seventy miles per hour in attempting to make up time. To provide a means of notifying enginemen of the proximity of a section of track on which a speed restriction has been placed, a special signal has been installed where the curvature of the track is such that a speed of forty-five miles per hour or less is required.

ARGO TERMINAL, O.-W. R. & N.

The Oregon-Washington Railroad & Navigation Co. has been running trains into Seattle, Wash., since January 1, 1910. However, at this time it had practically no terminal facilities at this point and since that time it has gradually been working with the end in view of making a modern terminal here, with provision for future expansion which is sure to take place. During the summer of 1911 a new concrete and steel passenger station, occupied jointly by the O.-W. R. & N. and the Puget Sound roads, was opened and just south of it a three-track coach yard was laid out. From here two tracks lead across the tide flats to Argo, a point about three miles south. Here there was a large flat tract of ground which necessitated considerable filling, but which gave ample room for expansion. It is expected that the yard will ultimately consist of a seven-track departure yard, a ten-track receiving yard, 21-track storage yard and a nine-track receiving and departure yard. At present but five departure tracks and four receiving tracks have been built.

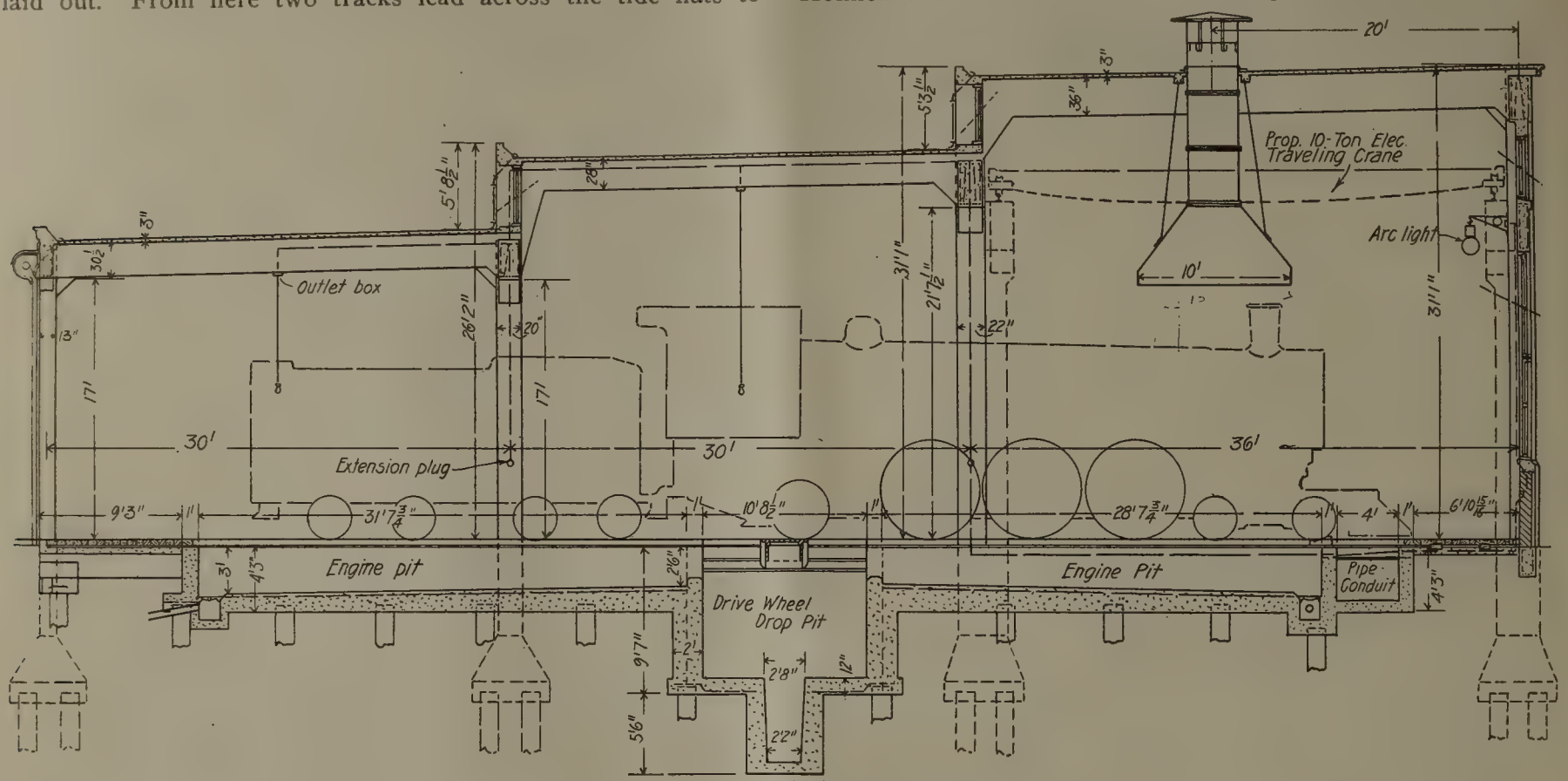
The buildings erected, together with the costs are as follows:

11-stall roundhouse	$50,000
41 ft. x 90 ft. power house	12,000
40 ft. x 120 ft. storehouse and 40 ft. x 50 ft. concrete platform	14,000
25 ft. x 80 ft. yardmaster's house	4,000
25 ft. x 30 ft. toilet building	2,000
40 ft. x 40 ft. oil house	2,600
180 ft. x 90 ft. machine shop	45,000
Coal chute	16,000
60,000-gallon tank	5,000

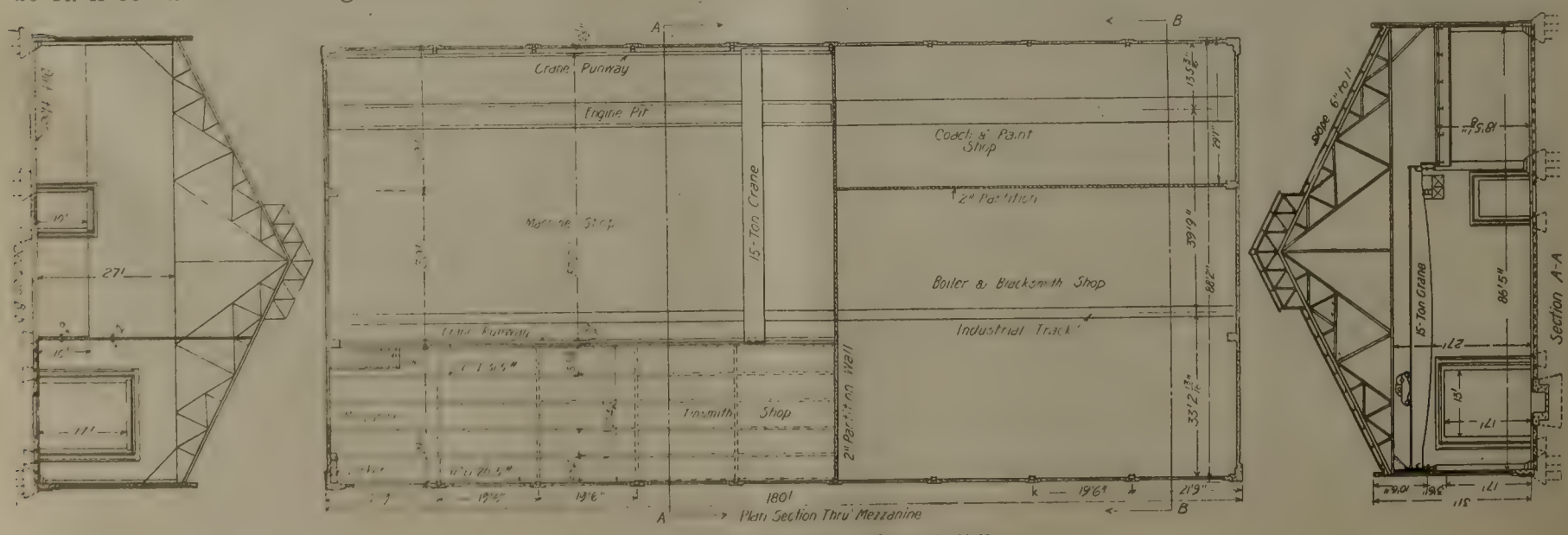
The roundhouse, storehouse, oil house, yardmaster's house and coaling station were completed in December, 1911, while the remainder of the buildings, including the machine shop and power house have just been put in service the past summer. The buildings are all of reinforced concrete construction.

The coaling station is of timber construction and of the Holmen two bucket counter-balance type, installed by Roberts & Schaefer Co., of Chicago. It has a capacity of 500 tons. The water tank is of steel, having a capacity of 60,000 gallons. Cinder pits are of concrete, with Robinson conveyors.

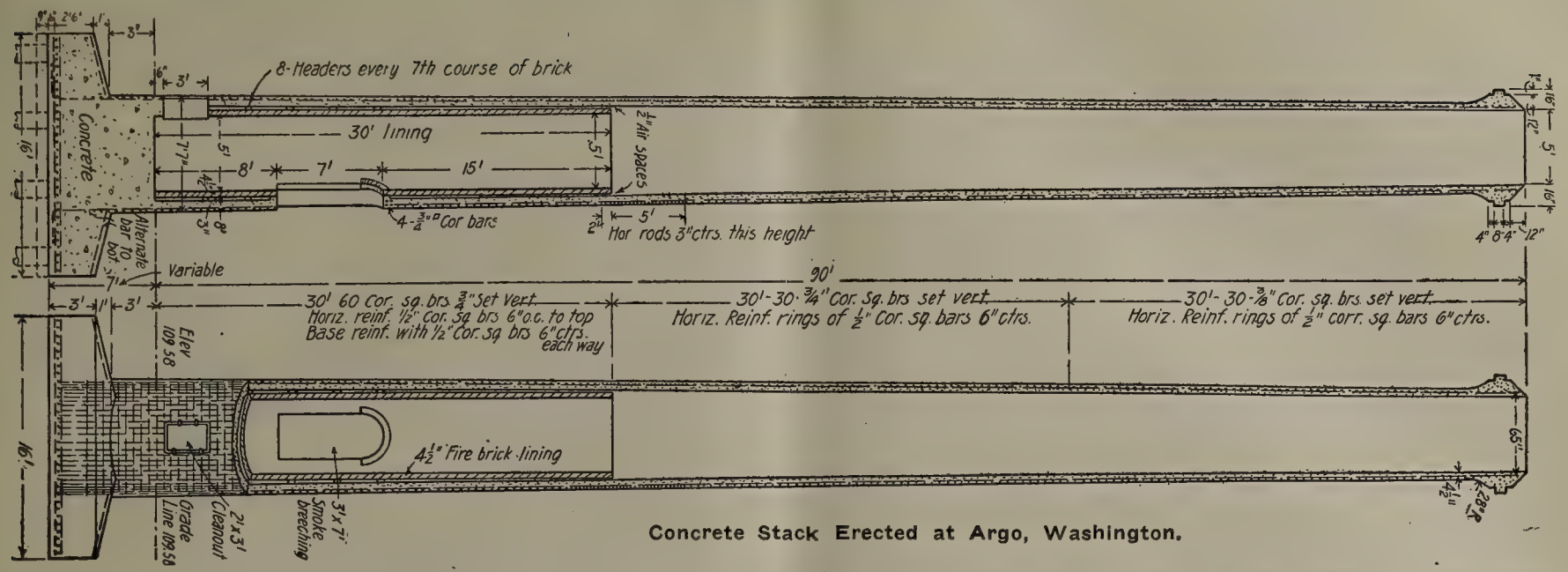
The roundhouse, including the roof, is of reinforced concrete construction, the inner and outer roundhouse circles being respectively 155 feet and 192 feet in diameter. But eleven stalls have been constructed at present, although provision has been made for ultimately completing the circle. Occupying one of these stalls are the foreman's office, store room, locker room equipped with wooden lockers, and boiler washing room, containing a White boiler washing system. The roundhouse floors are of 8-in. x 3-in. x 4-in. creosoted wood blocks, which, it may be noted, are becoming very popular for this work. A 3-foot gage industrial track follows the outer circle and parallel to it



Section Through Argo Roundhouse.



Plans and Sections of Argo Shop Building.


8-Headers every 7th course of brick
30' lining
Concrete
Alternate bar to bot.
Variable
4-¾"□ Cor bars
Hor rods 3" ctrs. this height
1½" air spaces
30'
30' 60 Cor. sq. brs ¾" Set Vert.
Horiz. reinf. ½" Cor. Sq brs 6" o.c. to top
Base reinf. with ½" Cor. Sq brs 6" ctrs. each way
30'-30-¾" Cor. Sq. brs set vert.
Horiz. Reinf. rings of ½" Cor. Sq. bars 6" ctrs.
30'-30-⅜" Cor. sq. brs. set vert.
Horiz. Reinf. rings of ½" corr. sq. bars 6" ctrs.
Elev 109.58
4½" Fire brick lining
2'x3' Cleanout
3'x7' Smoke breeching
Grade Line 109.58

Concrete Stack Erected at Argo, Washington.

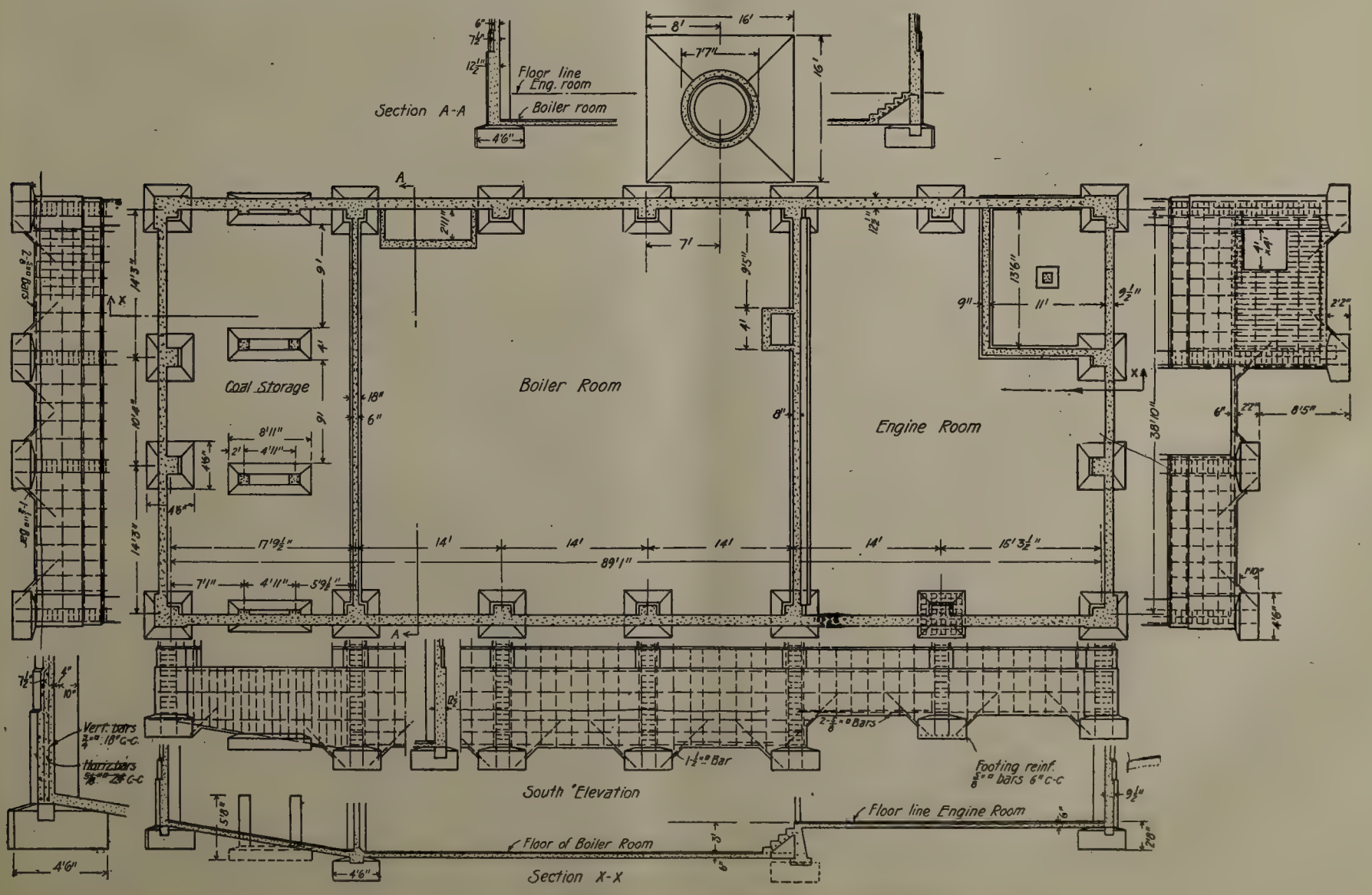
is a concrete conduit for steam and water pipes. As may be noted in the cross section view, the roof is formed by a series of three steps, the clere story windows as well as the outer windows being operated by Pond sash operating devices, and provision has been made in the plans for the future installation of a ten-ton electric crane. Kinnear vertical steel rolling doors are used at the inner circle entrances to the house. The smoke jacks are of "Transite," manufactured by the H. W. Johns-Manville Co.

Steam heating coils are placed in the pits and air pipes are carried on the columns. Bowser oil pumps are used in the oil house, which is a separate structure, 22 ft. x 30 ft. The turntable pit is lined with concrete and contains an 80-foot turntable equipped with a Nichols tractor.

The power house is of concrete with steel roof trusses and is divided into three sections, namely: a coal storage room, boiler room and engine room. There are two 263-h. p. Parker boilers and two Franklin 12-in. x 12-in. x 14-in. air compressors. Only part of the power house equipment has been installed, considerable space being left for future expansion. The chimney is also built of reinforced concrete and is 90 feet in height, resting on a 16 ft. x 16 ft. base, which is reinforced with ½-in. corrugated square bars placed 6 inches apart. The first 60 feet of the chimney has horizontal reinforcing rings of ½-in. bars placed on 3-in. centers and the last 30 feet is reinforced by ⅜-in. corrugated square bars set vertically. Joints in the reinforcement are lapped 30 inches. The bottom of the chimney is lined with fire brick to a height of 30 feet and is connected to the power house by a steel breeching.

The machine shop building is of concrete and steel, and contains, as may be seen by reference to the drawing, the boiler shop, blacksmith shop and paint shop. A 60-ft. 15-ton crane is to be installed in this building.

Fire hydrants are conveniently placed about the terminal, water and fire protection being afforded by the city. Vitrified pipe is used in the drainage system. For lighting, the multiple arc system is used. Grant, Smith & Co., of Seattle, were the contractors.



Plan and Details of Power House at Argo, Wash.

STEEL PASSENGER CARS.*

By A. Copony, Chief Draftsman, Car Dept., G. T. Ry.

It has always been the aim of railways to re-design and improve on existing passenger equipment, thus being in a position to take care of the ever-increasing demands for safety, speed, and comfort of the traveling public whose "wishes" are becoming imperative in those sections of the country where competition amongst rival lines puts zest into the fight for supremacy in the passenger transportation business.

Several eastern and middle western roads have tried to keep up competition by means of increased speeds of trains run under a provisional guarantee, granting a refund of part of the fare in case trains are not run on time, whereas Western and Transcontinental lines, not able to perceptibly reduce their time of travel, on account of single tracks, are keeping up their bid for passenger traffic by means of safer cars, greater luxuries, and increased comforts.

Since the advent of steel passenger cars the question of speed, comfort and safety has become more accentuated and the construction of these cars has become a matter of great importance, not only of the car department but of the motive power department, the transportation department, the maintenance of way department, and the public in general as well, besides which there is a rational limit set to the expenses incurred for equipment, by the definite returns expected from this investment.

In order to show the interest evinced in certain performances of the cars by the different departments of railroads the following diagram will be of value in the more explicit treatment of details.

(The departments are indicated by following abbreviations set next to the details in question.)

Car Department	C
Motive Power Department	M
Transportation Department	T
Maintenance of Way Department	W
Public	P

C	Construction.
C.	Construction details.

Repairs.

C	Maintenance Protection against oxydization.
C	Cost.
C-M-W	Weight.
C-M-W	Draft resistance.
C-T-P	Insulation.
C-T-P	Inside finish.
C-T-P-M	Heating.
C-T-P	Lighting.
C-T-P	Ventilation.
C-T-P	Sanitation.

In the construction of steel passenger cars all aforementioned points have to be carefully considered, besides which a host of other details have to be taken into consideration which depend on existing conditions under which a road is operating. For instance: It will be easier to build steel passenger cars operating in climates where the maximum and minimum temperatures of a year do not go to extremes, since the matter of insulation will not be as serious as in northern latitudes where the extremes are within a range of 120 degrees or more. Cars operating in a climate of great humidity will have to be treated differently in the selection of material as well as painting, compared to cars operating in a climate of low humidity. Cars operating in mountainous sections with short curves and heavy grades will receive closer attention as to running gear than cars operating in international or transcontinental service where the percentage of total run to run under the above-mentioned conditions will be comparatively small.

*From a paper read before the Canadian Railway Club.

In order to demonstrate the merits and demerits of constructions of different types, it should be only fair to judge a car not only in regard to the dead weight per passenger seated, but the consideration of comfort and safety shall not be omitted, and last but not least, the cost and maintenance as well as draft resistance per car is of vital importance, if not to the passenger, decidedly so to the railway.

Construction.

Not taking steel underframe cars with wooden superstructure into consideration and omitting the type of inside finish, we can split existing constructions into two different types, as follows: The double deck or monitor type and the single deck or turtle back car type.

Double Deck Type Car.

This type follows in its main outlines the wooden car construction closely and has been adopted by the Pennsylvania, the New York Central, the Wabash, the Delaware & Hudson, the Pullman Company, and others. It consists in the main of a steel underframe composed of centre and side sills, intermediate sills being in most cases dispensed with and substituted by pressed or structural steel bridging. The center sills are either of the fishbelly type built up of structural steel, or else consisting of heavy channels or "I" beams, as used by the Pennsylvania, the side sills are Z-bar channel or "I" beams, or simple combinations of the afore-mentioned sections, the whole being well braced and connected with substantial steel-bolster castings, pressed or cast steel end sills and built up platforms, or designed to fit into the commonwealth type of end-framing casting, which is a combination of platform and bolster cast in one piece.

The superstructure consists of post of pressed steel or structural shapes, connected direct to the side sills, as well as indirect by means of the side sheets to the side sills. In some designs side plates are used for the top connection of the posts, but the Pennsylvania and the Pullman standard type of sleepers show posts which connect in a clean sweep with the upper deck sills, thus eliminating lower deck carlins and side plates. In the first-mentioned case either single, pressed steel, lower and upper deck carlins are used, but a number of constructions show a combination of lower and upper deck carlins with deck posts, the whole being either pressed or of built up construction and applied while erecting the framing of the car. The Pullman standard design and Pennsylvania standard of upper deck is built up on the floor as a unit, consists of pressed deck sills, upper deck carlins, posts, roofsheets, deck plates of pressed or rolled stock, the whole being applied to the posts after the lower framing is up. Side sheets, roof sheets, letter board plates, etc., are made of spliced sheets, or in one piece where convenient, the older constructions showing splices at posts with invisible joints and countersunk rivets, which have been found rather expensive in construction and weak as far as countersunk rivets in thin plates are concerned.

The permissible combined stresses for this framing, considering weight, load, and end shocks, the latter varying from 300,000 to 500,000 lbs., are usually taken within the range of 15,000 to 18,000 lbs. per square inch, but the weight of the car depends to a great extent on the selection of carrying members of the car, some designers preferring to build an underframe of which the carrying members are contained in the underframe only, as side sills and center sills, thus keeping the center of gravity of the carrying section within a small distance from the point where combined buffing shocks resulting from drawbar and buffing device are received.

Other designers take the construction of side plates, sidesheets, belt rails and deckplates as carrying members of the cars into consideration and brace the sheets where necessary to prevent buckling. This construction has the advantage of permitting the use of a comparatively light underframe, but the center of gravity of the whole section is thereby raised and

larger bending moments resulting from buffing shocks are encountered, caused by the larger distance of center of gravity from the center of buffing shocks.

Roofsheets have to my knowledge not been considered for carrying members of this type of car, most probably on account of the comparative thinness of sheets and the minimum resistance to shear attained in the small sized rivets used for roof sheet connections, further on account of the complicated form of roof in general, although no buckling of sheets could be feared since they are curved to fit the outline of the roof and stiff enough in most cases to resist compression stresses at the center of the car.

The end framing of the cars are in most cases built up of heavy rolled sections, which are invariably stronger than the present day reinforced end framing of wooden cars, in order to prevent telescoping, some of the designers even using heavy platform posts back of the diaphragm as well, thus securing a double barrier against telescoping. There is no definite data as yet which would give a safe practical resistance to prevent telescoping, with exception of the assumption of sections by the U. S. Postoffice Department, these being of a section modulus of 65 at a height of 18 ins. above the floor level.

Omitting the advantages of steel cars over wooden cars entirely there are many points which point in favor to the double deck car. The main consideration of most of the railways that have led to the adoption of the double deck steel passenger cars were their general outline, which follows the old type wooden car, so that the general appearance of a train when made up of wooden and steel cars will not be spoiled. The traveling public, used to this deck construction, looks with favor upon the inadequate but visible ventilating device maintained through the decksash opening, and overlooks the more efficient but less noticeable ventilators applied to cars.

In sleeping cars the insufficient light entering the car through the deck sash is the only light besides artificial light that supplies the wants of an upper berth traveler for his early morning gymnastics called "dressing."

Not very much will be said in this place of disadvantages of the double deck type of steel passenger cars, since a comparison with the single deck type of car is inevitable.

Single Deck Type.

The single deck car underframe is built up in a similar way to the underframe of double deck cars, but it is a very rare case, indeed, that calls for a fishbelly type of center sills, a medium sized rolled shape being found to answer the purposes of construction in every way.

The superstructure up to the side plate above the posts, is the same as used with the double deck cars.

A carlin connects the two side plates in a single sweep, and is in most cases made of pressed steel. The roof sheets are applied direct to the carlin, but it is quite a common practice to use tar paper at the spliced joints in order to get a watertight connection between roof sheets. The application of tar paper for joints ought to be abandoned where roof sheets are carrying members of the car, since it is impossible to get and maintain an absolutely stiff joint in such places with this practice. The roof sheets are usually made heavier than in the double deck car type since a certain amount of deterioration is taken into consideration, so that after a series of years of axidiration the sheets are still strong enough to stand the strains they are subjected to.

The carrying members of the car are as follows: The center sills, side sills, side sheets, belt rails (if used in this construction), side plates and roof sheets.

The center of gravity of the carrying section of the car is naturally higher than in a double deck type, and the buffing shock leverage is naturally larger, but it is in almost every case possible to have a carrying cross-section weighing less per lineal foot than in a double deck type of car, since the tension and compression members are spaced a larger distance apart.

I do not know of a case where a steel platform casting has been used in this construction, since it has always been the aim of the designers to reduce the weight of this type of car as much as possible.

Fibre stresses and buffing shocks are kept within the same limits as mentioned for double deck cars.

The advantages of this type of car over the double deck type of car are numerous.

First of all the single roof construction with slightly increased thickness of sheets and a deeper curvature of roof permits the use of the roofsheets for carrying purposes which also permits cutting down of the side plate since a heavy side plate would not increase the section modulus of the car materially. There is no need of a special bracing of the roof sheets because the large curvature of the roof prevents buckling of sheets effectively. I would personally advocate in this type of car the omission of side plate and carlins entirely and have the posts pressed in such a manner that they would substitute the carlins, this means an extension of posts same as used on lower deck of Pullman standard sleeper, opposite posts being joined at the apex of roof by means of a splice plate and covered with the roof sheets in the conventional way. It will be harder to press these posts but incidentally the omission of side plates and carlins means a reduction in weight and labor, both of which facts mean a cheaper car, and, furthermore, an easy regulation of width of car over posts which is found difficult to maintain in pressed carlins, which are very liable to warp after pressing and while cooling, thus changing the width of car unless the carlins are repressed cold in a close-fitting die, which process is expensive and therefore to be avoided.

The air volume contained in single deck cars compared to the air volume of double deck cars of the same length is larger, at the same time the outside cooling surface of the single deck car compared to that of the double deck car is smaller, the body construction (labor and material) is cheaper than the double deck type, this can also be said of the total cost of inside finish. There are not as many bends and joints to be made when applying insulating material, which is a very important item for the successful insulation of cars. The head room of the car is generally higher in the turtle back type.

As these cars cannot be ventilated by the use of a deck sash more efficient ventilators are applied, which are either working in conjunction with the lighting fixtures or applied separately, as is the practice of the Harriman lines.

The reduction of light caused by the elimination of the upper deck sash is a matter that might be taken as a draw-back, but if one takes the amount of subdued light filtering through the old type artglass deck sash into consideration coupled with the amount of soot and dirt received through the same source, this advantage is turned to a decided disadvantage. In case the turtle back car should be used for a sleeping car design, the lack of light from the deck sash could be easily remedied by the application of skylights consisting of a cast oblong concave glass let into the roof in the center of the car, placed so that the convex side of the glass will project above the level of the roof, which will give the collecting soot and dust a chance to be blown off the smooth surface of the glass by the action of wind and rain.

A turtle back car would, on the other hand, provide decidedly more space for head room in the lower as well as upper berth, since the roof starts up at the posts with an abrupt rise, giving about 8 ins. to 10 ins. more total headroom at the center line of berth than a double deck car, which would mean an increase in headroom of from 4 ins. to 5 ins. per berth.

Despite the increased head room and air volume per passenger, the turtle back car is easier to be heated since there is no draft through deck sash, permitting heated air to escape when the ventilators are closed and further the slightly decreased total roof surface should be a great factor in keeping the car

warm on a smaller steam or fuel allowance than permitted for double deck cars.

Constructional Details.

Constructional details are matters that should take the whole attention of the car department of the railway and that of the contractor. The simpler details are worked out the easier it will be to replace them when in service, and although I am a firm believer in pressed pieces for car construction, I will concede that it is easier to replace standard angles or shapes than to replace the former.

The use of windows of different height and size in one type of car, as well as the use of half-elliptic deck sash of artglass above the window, are features that I would think objectionable from the purchaser's standpoint, since it is necessary to shape the outside steel sheets as well as the inside finish in many cases to the shape of this half-elliptic sash, which is an expensive job when executed in a repair shop without the aid of dies or presses. The different sizes of windows means a larger number and more frequent changes of dies in the contract shop, which operation takes time and money, on account of the greater number of templets and dies used and the work connected with these changes, the bill of which must be footed by the purchaser without gaining any visible advantage excepting perhaps the rather doubtful pleasure of keeping a larger number of window panes or sash in stock to suit the different sizes of windows, since the saving in glass caused by different construction is a negligible quantity.

Road	Kind of Car	Type of Roof	Seating Cap'ty.	Carrying Cap'ty	Trucks	Weight of 2 Trucks	Dead Weight per Passenger	Dead W'gt. per 100 lbs. Load	Light W'gt. of Car	Length over End Sills	Floor Insulation	Side Insulation
El Paso & South Western	Baggage	Double Deck		Not given	6 Wheel	41,500 lbs.			124,400 lbs.	66′-0″	$1\frac{1}{16}$″ Magnenite	1 ply Resisto
Pullman	Standard Sleeper	Double Deck	59 appr. 27 B'ths. appr.		6 Wheel	45,300 lbs.	2574 lbs. per Pass. 5624 lbs. per Berth		151,850 lbs.	73′-6″	Magnanite	1 ply Resisto
Western Pacific	Coaches	Double Deck	84		4 Wheel	30,400 lbs.	1,379 lbs.		115,800 lbs.	70′-0¾″	1½″ Hairfelt pressed to 1″ Space	¾″ Salamander and ¼″ Ceilinite
Chicago Great Western	Coaches	Double Deck	84		6 Wheel	41,250 lbs.	1,625 lbs.		136,500 lbs.	72′-6″	$\frac{3}{16}$″ Hairfelt	1 ply Resisto
Lehigh Valley	Coach	Double Deck	72		4 Wheel	27,800 lbs.	14,176 lbs. to 1,538 lbs.		102,000 lbs. to 110,700 lbs.	60′-0″	¾″ Salamander	¾″ Salamander
Pensylvania	Coach	Double Deck	88		4 Wheel	Not given	1,330 lbs. to 1,318 lbs.		117,000 lbs. to 116,000 lbs.	70′-3½″	Asbestos Mill Board	Ceilinite
New York, N.H. & Hartford	Coach	Double Deck	72		4 Wheel	Not given	1,361 lbs.		98,000 lbs.	60′-10″	Hairfelt	Hairfelt
Atlantic Coast Line	U. S. Mail	Double Deck		60,000 lbs.	P.RR. Type 6 Wheel	46,020 lbs.		200 lbs.	120,000 lbs.	64′-2″ over Buffers	¾″ Paper Quilted Hairfelt	¾″ Cloth Covered Hairfelt
New York Westchester & Boston	Interurban Coach	Double Deck	78	20,000 lbs.	4 Weeel	41,680 lbs.	1,538 lbs.		120,000 lbs.	72′-7″ over Buffers	¼″ Agasote	¾″ Cabot's Quilt
Delaware Lackawana & Western	Coach	Double Deck	78		4 Wheel	Not given	1,235 lbs.		100,250 lbs.	60′-7½″	Salamander Felt and Resisto	Salamander Felt and Resisto
Baltimore & Ohio	Coach	Double Deck	80		6 Wheel	Not given	1,611 lbs.		128,900 lbs.	70′-0″	Salamander Felt	Salamander Felt
C. R. I. & P.	Coach	Double Deck	86				1,615 lbs.		138,860 lbs.	70′-1″	Asbestos Mill Board	Ceilinite below Beltrail
New York Central Lines	Coach	Double Deck	84		6 Wheel		1,162 lbs.		139,700 lbs.	70′-0″	Salamander Felt	Resisto
St. Louis & San Francisco	Postal Car	Double Deck		60,000 lbs.	6 Wheel	42,300 lbs.		193 lbs.	115,700 lbs.	60′-10″	$\frac{3}{16}$″ Asbestos	½″ Hairfelt
Western Pacific	Baggage Car	Double Deck		50,000 lbs.	4 Wheel	31,000 lbs.		205 lbs.	102,300 lbs.	60′-10⅝″	⅛″ Asbestos and ¾″ Salamander	Salamander 2 thicknesses of ¼″
Duluth Missabe & Northern	Coach	Double Deck	84		6 Wheel	42,000 lbs.	1,724 lbs.		144,800 lbs.	70′-8″	Mineral Wool	Salamander 4 thicknesses of ⅛″
Duluth Missabe & Northern	Baggage and Mail Car	Double Deck		50,000 lbs.	6 Wheel	42,000 lbs.		272 lbs.	136,000 lbs.	70′-8″	Mineral Wool	Salamander 4 thicknesses of ½″
Missourie Pacific	Postal Car	Double Deck		60,000 lbs.	6 Wheel	40,000 lbs.		185 lbs.	110,700 lbs.	60′-10″	¼″ Asbestos	⅛″ Asbestos
Canadian Pacific	Coach	Double Deck	84		4 Wheel		1,366 lbs.		114,800 lbs.			
Southern Pacific	Baggage-Car	Turtle Back	None	Not given	4 Wheel	26,300 lbs.		Not given	88,800 lbs.	60′-1½″	1″ Hairfelt	½″ Salamander
Southern Pacific	Coach	Turtle Back	72		4 Wheel	26,450 lbs.	1,342 lbs.		96,600 lbs.	59′-10″	1″ Hairfelt	½″ Salamander
Ill. Central	Coach	Turtle Back	72		4 Wheel	27,600 lbs.	1,457 lbs.		104,900 lbs.	59′-10″	1″ Hairfelt	½″ Salamander
Southern Pacific	Interurban Coach Motor Car	Turtle Back	116	250 lbs.	4 Wheel	30,540 lbs.	662 lbs.		76,824 lbs.	58′-6½″	Flexolith Floor	None
Southern Pacific	Interurban Coach Trailer	Turtle Back	116	250 lbs.	4 Wheel	19,240 lbs.	565 lbs.		65,524 lbs.	58′-6½″	Flexolith Floor	None

Table Showing Use of Steel Cars (continued opposite).

It is, however, erroneous to suppose that it is necessary to employ large hydraulic machinery, big squaring shears or multiple punches to do the repair work, as I have seen shops that built cars commercially successful without any of the heavier type of machinery used in freight car construction.

In regard to the means of permanent connection of several units in steel passenger car construction we have at present only two methods that are to be mentioned here and these are riveting and spot welding.

The former, most commonly used, is a source of a great deal of trouble and expense in the erection of the cars since it means a lot of preparatory work before a rivet can be driven. All material must be center-punched, marked, punched to different rivet sizes, which causes in many cases rehandling of material on different machines, or resetting of single machines, assembling, reaming and riveting. Rivet holes never meet as perfect as the drawings show them to meet, and the only means of getting the rivet holes right is by punching them smaller and reaming them to size afterwards when assembled. This process is very expensive as to labor and there is no assurance that the rivet will fill the hole after being driven. I have seen rivets driven in holes that were about 3/8-in. too large, so that the hole was covered up by the rim of the rivet instead of being

Roof Insulation	Interior Finish	Heating System	Lighting System	Ventilation	Built By	Remarks
1 ply Resisto	All Steel	Chicago-Vapor	Willard Electric Axle Device Batteries and Fixtures	6 Garland	Pullman Company	Exceptionally Long Body
1 ply Resisto	All Steel	Chicago-Vapor	Bliss Axle Device National Battery Lamps and Berth Lights	13 Garland	Pullman Company	Seating and Berth Capacity Not Given on Original Information Sheet
3/4" Salamanner	All Steel	Chicago-Vapor	U. S. L. & H. Co. Axle Device Nationall Battery Pendants or Deck Rails	None	Pullman Company	
1 ply Resisto	Mexican Mahogany	Pullman Heater with Safety Jacket	Safety Axle Device Willard Battery or Electric Pendants	None	Pullman Company	
3/4" Salamander	All Steel Agasote Wainscoting	Ward Unitherm	U. S. Type M National Batteries Pendants. Electric	18 Ward Ventilator	Pullman Company Standard Steel Car Company	
Ceilinite	Steel and Comp. Headlining	Chicago Car Heating Co.'s System	Axle Device Batteries Centre Lights	P. R. R. Stand. Forced Air	Pullman Co. Standard Steel Car Co. Pressed Steel Car Co. A. C. & F. Co., Berwick, Pa.	
Hairfelt	Steel	Electric	Direct Electric	Automatic	Standard Steel Car Company	
3/4" Cloth Covered Hairfelt	1/16" Flat Steel Plate	Gold-Vapor	Axle Device Storage Battery. Electric	Decksash Ventilation	Pressed Steel Car Company	
3/4" Cabot's Quilt	Agasote 2/16", 1/4" and 1/8"	Electric Direct	Electric Direct	12 Garland or Gold	Pressed Steel Car Company	Central and End Doors. 1 Motor and 1 Trailer. Truck Roof. Double Deck. Modification Turtle Back Type
Signal's Brand Roofing Insulator and Resistor	Ash and Agasote Headlining	Gold Direct Pressure and Vapor	Ascetylene Gas	Automatic	A. C. & F. Co., Berwick, Pa.	
Salamander Felt	Oak and Agasote Headlining	Direct Steam Gold	Electric and Pintsh Gas	Deck Sash and Globe Vent.	A. C. & F. Co., Berwick, Pa.	
None	Mahogany with Agasote Headlining	Chicago Vapor Steam Spear Stove	Electric Lighting Axle Device Storage Batteries	Garland and Globe	A. C. & F. Co., Berwick, Pa.	
Resisto	Steel, Agasote Headlining	Ward Heating	Axle Device Storage Batteries. Electric	38 Ward	A. C. & F. Co., Berwick, Pa.	
1/2" Hairfelt	1/16" Steel	Thermo Jet Steam Heat	Axle Device Willard Storage Batteries Electric	Deck Sash Ventilation	A. C. & F. Co., St. Charles, Mo.	
Salamander 2 thicknesses of 1/4"	16 and 20 Gauge Corrugated Steel	Chicago Car Co.'s Steam Heat	Axle Device 16-cell Storage Battery Electric	Deck Sash Ventilation	A. C. & F. Co., St. Charles, Mo.	
Salamander 2 thicknesses of 1/2"	Steel	Gold Duplex Steam Heat	Axle Device 16-cell Storage Battery Elcctric	Deck Sash Ventilation	A. C. & F. Co., St. Charles, Mo.	
Salamander 2 thicknesses of 1/2"	All Steel	Gold Duplex Steam Heat	Axle Device 16 Batteries. Electric	Deck Sash Ventilation	A. C. & F. Co., St. Charles, Mo.	
None	16 and 11 Gauge Steel	Gold Direct Steam Vapor	Pintsh Gas 10 Mantle Lamps	Deck Sash Ventilation	A. C. & F. Co., St. Charles, Mo.	
	Const. Steel Veneer				Canadian Pacific Angus Shops	Individual Truck Brake Cylinder. Steel and Wood Veneer Inside Finish. Empire Style Shaped Outside. Steel Roof
1/2" Salamander	All Steel	Chicago Vapor	Pintsh Gas and Electric	12 Globe Vent. Staggered	Pullman Company	Carries Steam Turbine and Electric Generator Set
1/2" Salamander	All Steel	Chicago Vapor	Pintsh Gas and Electric Axle Device and Battery	18 Globe with Registers Staggered	Pullman Company	
1/2" Salamander	All Steel	Chicago Vapor	Electric Gold Axle Device and Lights	18 Globe with Registers Staggered	Pullman Company	
None	Steel Panels Above Windows		Direct Electric	9 Globe	A. C. & F. Co., St. Charles, Mo.	No Inside Finish except Steel Panels above Windows
None	Steel Panels Above Windows		Direct Electric	9 Globe	A. C. & F. Co., St. Charles. Mo.	No Inside Finish except Steel Panels above Windows

Use of Steel Cars.

filled by the rivet-shaft, but here I must not forget to state that this was on freight car work.

Spot welding, though at present only out of the experimental stage, promises to eliminate all this trouble. Sheets and pressings are trimmed to size, placed in jigs, representing side or end of car and welded up with a specially designed spot welding machine.

These welds will stand about 30 per cent more in shear compared to a rivet of the same size in a punched hole, the whole structure will be stiffer than a riveted structure of the same design since there is no surplus space in a rivet hole that would permit the sheet to shift when under stress. The testing of spot welded joints is as easy as the inspection of riveted joints, but it would be advisable to have the inspectors watch the welding process, as well as inspect the weld after cooling. The former inspection will prevent a poor weld being made by watching the flash between sheets, which is invariably a sign of perfect weld, the second inspection being confined only to rapping the weld with a hammer and judging by the difference in tone to that of the unwelded portion of the sheets. Both inspection methods should supplement one another and should be especially applied to heavy welding work in carrying members of cars, since the use of spot welding in connection with steel inside finish would hardly call for more than a general inspection. There is no doubt at all that this is the future of the steel freight car, and I am certain that electrical spot welding will be successfully adopted for all steel passenger cars as well. The commercial success of this method is guaranteed, since this process will mean a considerable reduction in the price of cars, amounting to 3—3½ per cent of the price total of the car figured on a riveted basis.

Maintenance.

The maintenance of steel passenger cars is one of the most serious questions of railway companies at the present date, excepting, of course, those roads that are in a position to build their own cars and who, therefore, can take care of the repairs of their equipment with the machinery they use for the construction of new cars. Another item which had not been heeded well enough in the first cars built, and which is now going to bother those members of the railway fraternity that have to keep the cars in working condition, is the question of rust protection in places not visible, between outside shell and inside finish of cars.

We know that a body kept at a certain low temperature and afterwards transferred to a place of higher temperature with a high percentage of humidity will sweat or condense moisture on its surface, until the body has risen in temperature to that of the surrounding air, at which point the condensed moisture will be slowly absorbed by the air. The amount of moisture taken up is largely dependent on several factors, like the ductility and temperature of the condensing surface, thickness of sheets, moisture, temperature and volume of surrounding air.

In steel passenger cars the inside face of the outside steel shell is that part of the car most subject to this occurrence, and what conditions are prevalent at this particular place?

The steel sheets were sandblasted, and after that given either a coat of red lead mixed with an indifferent grade of linseed oil of the quick-drying "gasoline" variety, or the car is coated on the inside with two or three coats of poor varnish. On top of this we apply by means of wooden strips or O. H. S. straps a layer of ⅜-in. to ¾-in. hair felt insulation quilted in paper, the whole being enclosed by anything but an airtight inside finish.

In the winter time the temperature in the car is kept about constant, the humidity is rising, caused by exhalation of the passengers, reduced ventilation only takes place, and the result of this is that a highly humid air current is set up in the space between outside and inside shell of car, caused by leaks in the inside finish. The outside shell of car is constantly cooled through the movement of the car, condensation takes place on the inside surface of the outside shell, the force and extent of which is dependent on the care and material with which the sheets have been coated. The condensation freezes between the hair felt insulation and the outside shell. Warm weather sets in, the ice thaws, the water settles at once in the hair felt from which place it is hard to dislodge. Meanwhile freezing and thawing have some influence on the sheet insulation material, the coat of paint naturally poor, has given way in the form of cracks, flaking off sets in and the moist hair felt will start rusting in a very short time.

A better system of rust protection has been introduced of late, consisting of the application of an elastic coat of varnish applied to the sand-blasted inside surface of the outer shell, which is covered before setting with a blast of finely broken cork dust. This process can be repeated several times until the treated surface becomes almost non-condensing, by reducing ductility through the cork layer, after this the hair felt is applied by means of nails previously welded to the inside surface of the outside shell, by means of their heads, the points projecting inwards. The hair felt or other insulation material is impaled on these nails and the latter bent over after the insulation sheets had been pushed to the outside sheets. This prevents the movement of hair felt on the surface of inside shell and consequently keeps the cork surface in good condition. I think it would be worth while to improve further on this system by means of a waterproof coating on top of the quilting and a careful pasting down of insulation joints in order to prevent every possibility of water condensing on the sheets.

In an experimental way the use of calcium chloride applied in fixed receptacles between outside and inside shell would be worth while trying, since the latter is a powerful moisture absorbing agent without doing any harm to steel or metals. In all cases the inside finish ought to be applied as tight as possible and all fissures closed. The application of sheething to the outside of steel cars in imitation of wooden cars, consisting of a series of sheets, pressed or drawn to the well known keystone shape and fastened to the carrying sheets by means of screws or rivets placed in the depressions of the sheets, which in turn are covered by keystone-shaped steel troughs fitting into the dovetails of the first applied sheething and placed in position by sliding same into place from the side sill edges of the car, after the troughs have been coated with a specially prepared varnish, has not proven very successful. The composition material smeared into the keystone openings or the later used wooden blocks visible on the bottom edge of the cars have dropped out in places in the course of time, moisture got in and you can imagine the result in some of the cases after a lengthy exposure.

A handy tool for the repair of damaged steel cars and for any class of passenger car work as well, is one of the gas-welding outfits with cutting attachments now so popular in the car shops of this continent. The system used is more or less dependent on the work to be done and the facilities on hand.

Oxygen-hydrogen welding will be welcomed at those places where direct electrical current is obtainable at low prices and the use of a supplementary acetylene tank for the mixture of hydrogen with acetylene for welding purposes will permit the raising of welding temperatures from 3,900 degrees for the oxygen-hydrogen system to 4,900 degrees, which temperature is more than enough for any kind of work in the steel passenger car repair shop.

Oxygen-acetylene, oxygen-oilgas, oxygen-blaugas, and oxygen-coaloil vapor-gas welding outfits and the scope of their work are at present so well known that it is hardly worth while to go into details.

When looking forward to electrically welded (spot-welded) steel passenger cars, the question of repairs is seen in an entirely new aspect. As long as the use of patches, as for instance in freight car service would be permissible, the item of repairs would be easily enough answered, but I am sure that no

railway company of the present day would permit the use of visible patched cars, or would even tolerate the use of rivets for the replacement of the new sheets. Joints of spot-welded sheets are hard to separate, since there are no rivet-heads to be cut off, which would permit the separation of a combination into its units. The cutting torch would have to be employed to cut the damaged sheets or rivets out, after which the remaining strips of material of the damaged sheets welded to the uninjured sheets would have to be separated by means of heating with the welding torch, rolling up of the impaired material, and cutting welds with torch or chisel.

In the construction of spot-welded cars considerable care would have to be taken in designing the car, so that in case of repairs the repaired parts are accessible with the spot-welding machine, since rivet joints would be excluded from use, as they would not fit in with the design of the uninjured part of the car.

All these questions are, however, solvable, and they will be eventually simplified by the use of specially designed tools for this purpose, so that these apparent drawbacks will more than outweigh the cheaper construction and the greater rigidity of the joints.

Cost and Weight.

The cost of any type of steel car will depend on the type of car, the seating capacity, the inside finish, the equipment, insulation, etc., but we shall not forget in this place that the cost of a car built of a certain material, in this case steel, will be in a sense direct proportionate to the weight of the car, and for this reason the selection of the type of the car will be of utmost importance. The selection of an economical type of section which combines the greatest strength, not forgetting shear, with the least area, will naturally keep the weight of the car body within certain desirable limits.

The avoidance of a great number of differently pressed parts will also have a definite bearing on the price of the car, and if we have to consider that a light car (avoiding, of course, extremes which would impair the life of the car for length of service), is in two ways desirable from the railroad standpoint, the first being initial cost and the second and most important point is that the hauling expenses per car will diminish despite the fact that the traction force per ton will increase for light weight cars. For this reason we are showing that the weight of a car is also of interest to the motive power department, in the diagram. In the tables giving the details of steel passenger cars a column shows the dead weight of car per passenger, and although this value is fluctuating we will have to admit that it ought to be within reasonable limits for certain classes of cars.

In looking back upon the history of transportation we find that a horse-driven carriage will weigh about 1,500 to 2,500 lbs., seating at an average four passengers and a driver, which brings the dead weight per passenger from 300 to 500 lbs. This vehicle will move at a speed of 6 to 8 miles per hour over a roadbed not comparable to the worst kind of railway track.

An automobile, weighing 5 tons, seating 7 passengers and containing its own power plant, moving with almost the same average speed as a passenger train over a far inferior road-bed compared to a track, will bring the dead weight per passenger to 1,428 lbs. The dead weight per passenger of a steel railway coach amounts to from 1,200 to 1,700 lbs., and permitting the points of superior comfort and safety to be balanced by the poor roadbed and the weight of the power plant of automobiles we must ask the question: "Is there no possibility of getting below the automobile limits of dead weight per passenger, and is this reduction possible without sacrificing safety and comfort?"

The possibility to obtain better results is certainly within our grasp and it is a matter of application to attain better results with the superior material we employ in the construction of the car of today compared to the inferior bulky material of the wooden cars of yesterday.

Draft Resistance.

Until quite recently it has always been our aim to meet the natural demand for faster and larger trains, with an increase in power and speed developed by our engines, until we have pretty nearly reached the limit by the natural limitations of the grate surface. The next step to take to prepare for further demands for further increase of speed or length of train, would naturally be the reduction of draft resistance per ton of dead weight.

Draft resistances are made up in the main of air or skin resistance, friction resistance in the bearings, flange friction resistances, rolling friction resistances between wheels and rails, power losses caused by unbalanced wheels and last but decidedly not least, slip.

Flange friction resistances are to a certain extent avoidable, rolling friction between wheels and rails are unavoidable and a reduction of this resistance cannot as yet be considered possible, although there are some products on the market that claim to overcome this trouble of flange friction resistances to a certain extent. The power losses by unbalanced wheels on tracks shall be here entirely neglected. Next in importance is the question of skin friction or air resistance.

Leaving all theories of wave lines for passenger trains unconsidered the following theory is advanced by scientists:

A smooth surface offers more resistance in form of skin friction to an air current than a comparatively rough surface, because air is held in the cavities of the rough surface for a certain length of time, thus only permitting the high spots of the surface to hit the passing air, and as the friction between air and air is less than between air and a smooth solid body the resistance of rough surfaces is smaller. It would be worth while to put this theory to a practical test on railroads, but it is a question if it could be used to advantage since a rough surface offers better opportunities for dust and soot to settle and cling to the car, and is harder to dislodge in the cleaning yards, than from smooth surfaces. If this theory should hold good for dull surfaces some advantages could be derived in the general appearance of the car since it is impossible to prevent slight buckles with even the very best of care and the use of so-called "patent level" material, which are shown up by a glossy coat of varnish, which defect could be effectively covered by the use of a dull finished surface.

Baring friction, one of the main factors of train resistance, is one of the points that was apparently neglected until quite recently.

We must concede, of course, that a lot of improvements have been made in the use of anti-friction metals, but the main issue, the conversion of gliding friction into rolling friction, which would signify a considerable reduction in draft resistance, has been woefully neglected. I am sure that this neglect, or rather the lack of interest shown in taking this matter up for high class passenger rolling stock has had many reasons that could serve as an excuse. Excluding ball bearings entirely, the reasons held against the application of roller bearings were the high pressures to which rollers were subjected, the complication of design and the high initial cost of the bearings, the possibility of an absolute locking of axle, if one of the rollers should break, and the danger resulting therefrom to the passengers, the difficulty of repairs, the end thrust that has to be taken care of, and a lot of other objections of lesser importance.

It shall not be denied that several leading railroads of the country have carried on experiments in years gone by, but the result was in many instances not encouraging. The pressures on the rollers made of impure and not properly hardened steel were excessive, the rollers broke, the wear was excessive where pressures had exceeded a certain limit, so that the application of roller bearings was confined to light rolling stock only, and although it was conceded that the results derived from roller bearings were favorable when the cars were run at low speed the draft resistances at higher speeds were increasing rapidly

and exceeded in some cases those of gliding friction bearings.

As to these objections much can be said that will put the roller bearing in a more favorable light for consideration.

Heat treatment of special high grades of steel and the use of vanadium in the manufacture of steel has made the rollers tougher and harder, so that they can be subjected to higher pressures with impunity.

End thrust bearings were designed to take care of the end thrust of axles and it can be only a question of time and experiments until a roller bearing for cars will be evolved that will meet all requirements so that the saving in drawbar pull will more than counterbalance the extra expense of roller bearings.

One other factor in making up our drawbar resistance is slip. The percentage of slip is varying and increases with the difference in diameters of mated wheels on one axle.

Although all our railroad shops pay special attention to this fact when they are turning out new or repaired passenger equipment out of their shops, it is impossible to maintain equal diameters for any reasonable length of time, since the difference in finish of cut, material, carbon percentage, hardness, etc., are different in every wheel and in every brakeshoe, so that the best diameter balance will be upset in the shortest time. To investigate the amount of slip in actual service and the increase in drawbar pull necessitated by these gliding friction losses at high pressure would be highly interesting, the more so since the drawbar pull alone is only one factor that is mentioned here. The wear on tires and rails must be excessive since the pressure per square inch of contact between wheel and rail is very high.

To prove this assertion following figures based on a theoretical modulus of gliding friction of 0.75 between steel and steel for exceptionally high pressures per square inch and without lubrication are set down.

The assumption is a train, consisting of 6 coaches of 60 tons weight each, the diameter of wheels differing ¼ in. and the train being carried to a distance of one mile. The foot pounds of drawbar pull to move a train at a speed of 45 miles per hour, with a pull of 17 lbs. per ton, is equal to:

$17 \times 6 \times 60 \times 5280 = 32{,}313{,}600$ foot pounds.

Revolutions of axle with a standard 36-in. wheel per mile $= \frac{5280}{3.1415 \times 3} = 559$ revolutions per mile.

Slip per revolution in inches $= 0.25 \times 3.14159 = 0.785$ inches.

Total slip in feet per mile $= \frac{0.785 \times 559}{12} = 36.56$ feet.

Friction loss in ft. lbs. $= \frac{36.56 \times 6 \times 120000 \times 0.75}{2}$

Friction loss in ft. lbs. = 9,875,000 with load of train.

The friction loss in ft. lbs. with load of train is, therefore, equal to 30.5 per cent of the total drawbar pull.

These figures are, of course, only based on theoretical assumptions and are used to point a way to investigate one of our heaviest power losses. There is no doubt that the percentage of this resistance will change materially with the speed of trains and weight of cars, and further we maintain that the bulk of flange wear is caused by this difference in diameter of tires, since there is always a lot of play betwen journal box and journal brass which permits a constant twisting of the axle caused by the afore-mentioned forces which results in the tendency to climbing of flange on rail.

The trouble of slip could be overcome by the application of individual wheels to the truck, or simpler still by the use of sleeve shafts. It would be going too far to advocate the application of this principle for which a practical solution will have to be found to our present day trucks, but the time will come some day when the reduction of draft resistance will become imperative, and if we would find means of reducing our draft resistance some 50 per cent to 75 per cent it would mean that we could haul just twice as many cars at the same speed we are using today without any increase in power.

Insulation.

The insulation of steel cars is in the general opinion of most car builders one of the few points that have been seriously neglected in the past, and of which it cannot be said that an effective solution has been applied as yet to suit our Canadian climatics conditions, but there is no cause that could prevent the solution in an effective way.

As has been pointed out previously the method of insulation depends primarily on the extreme weather conditions of those parts of the country in which a certain car will be used.

Heat will be transmitted by one more or all of the three phenomena, conduction, convection, and radiation. The conduction of heat in all steel passenger cars will be naturally far higher than in wooden cars, the more so since the material in steel cars is far thinner than in wooden cars, the coefficient of condition of the two materials comparing 24:0.17 or 141:1.

The losses of heat through convection would be about the same in steel and wooden cars, but the losses through radiation would be naturally greater in steel cars since more heat is transmitted by means of conduction to the outside surface of the steel car.

Luckily, however, we have means of checking the losses by radiation and conduction to a marked degree in a lot of the composite materials put on the market for this purpose. The selection of a proper insulation material is made hard by the fact that no scientific investigations into the conductivity of these composite materials are available which would aid the car builder in his task. In order to cut the loss of heat by conduction the employment of entirely closed air cells of small dimensions is suggested, the latter being built up of poor conductors of either organic or inorganic origin on basis of the principle of hollow tiles.

The process of applying insulating material to the inside and outside shell of steel cars gives poor results since it is practically impossible to prevent the leakage of air into the large air cells between the insulations and between the insulation and the outside or inside finish. In those cases where the application of the inside finish has to be done direct to the steel structure of the car, like carlins and posts, the use of an intermediate porous material like corkstone, asbestos, or magnesia, is recommended to reduce losses through conduction, the method of fastening the latter being a matter of design and experiments only. Even the application of light wooden strips, although better conductors than corkstone, would be recommended for the ease of applying by means of bolts inserted in keyhole slots of the posts and carlins.

Inside Finish.

The question of inside finish is considered in most cases as a matter of appearance only, but, nevertheless, the proper selection of inside finish material should be based on results of experimental investigation.

The objections to wooden inside finish for steel passenger cars are weight, combustibility, splintering in case of wreckage, warping, and there is the possibility of trouble caused by the different expansion of the outside and inside shell of cars. The use of steel for inside finish of steel passenger cars has also its disadvantages foremost of which is high conductivity, poor resistance to denting by baggage, on account of thinness of material, the possibility of condensation, and rusting of finish from the inside out, and some minor disadvantages like buckles and dents which show up after finish has been varnished and painted. The combination of wood and steel has been attempted by several railways for inside finish, consisting in the application of veneer to steel by means of a binder direct, or by means of an intermediate material to receive a binder, but to my knowledge these experiments have been more or less of a failure on account of the different expansion of materials like wood and steel. I do not see why wood should be combined

with steel, if not for the only reason of reducing weight and the prevention of splintering in case of wreckage, for the reduction of conductivity by the application of veneers is small and does not count from the standpoint of insulation. The best material for inside finish would be sheets that combine poor conductivity with small weight, fireproof properties and a certain amount of resistance to destruction, and, I think, that several or all of these properties can be found in many of the composite materials made today by different concerns, for ceiling finish, of material like asbestos, wood-pulp, or other vegetable or mineral bases made fireproof or semi-fireproof and homogenous by different patent processes. Before using any of the composite materials exclusively it will be necessary to carefully ascertain the properties of conduction, fire-resistance and resistance against rotting, the latter only where the basis of the sheets is of vegetable or animal matter.

The manner of applying inside finish is also of great importance. Inside finish for steel passenger cars should be easily removable and easily appliable to cars after the cars have once been fitted so that it will be possible to inspect the insulation and the condition of the framing at least once a year for the first two or three years after the car is put in service.

ARTICULATED TRUCK ELECTRIC LOCOMOTIVES, N. Y. N. H. & H. R. R.

Work is now well under way on a consignment of thirty-nine heavy-service, electric locomotives which are being built by the Baldwin-Westinghouse combination for the New York, New Haven & Hartford R. R., for use on its lines between New York and New Haven. This is one of the largest consignments of electric locomotives that has ever been under construction and is of further interest in that the design adopted is considerably different from any heretofore used for electric engines and in that thirty-six of the engines are arranged for single-phase service only. There are no decidedly new features involved as all of the methods used have been heretofore employed. But never before have they been utilized in the combination devised for these thirty-nine engines.

In their construction have been combined what have been shown in every day road service to be the best features of the heavy locomotives, that have been built in the past. An 8-motor driving arrangement similar to that first used in the 069 New Haven Locomotive and an articulated running gear similar to that used for the 072 class locomotives have been adopted.

Each engine is driven by four twin-motor units—8 motors in all—with one twin motor unit mounted over each driving axle. This arrangement has shown itself to be a very desirable one for the following reasons:

1. Peripheral speed is a limiting feature in rail-motor design. With two small motors it is possible to use a rotative speed approximately twice that possible with one large motor. Each motor has therefore one-half the number of poles of practically the same size as would be required by one equivalent large motor. Therefore two of the small motors have practically the same number of parts such as field coils, armature coils, and brush holders as would be required by one large motor.

2. Each of the small motors has a diameter practically half of that of one equivalent large motor hence a saving in weight and space results.

3. A further saving in weight results because each small motor exerts but one-half the torque that must be exerted by one equivalent large motor; therefore a single gear meshing with the pinion of each motor can be used in place of two gears necessary with a small motor of the same total capacity.

4. The use of single gear being possible because of the reason of item 3, the motor can be longer which permits of a more economical design.

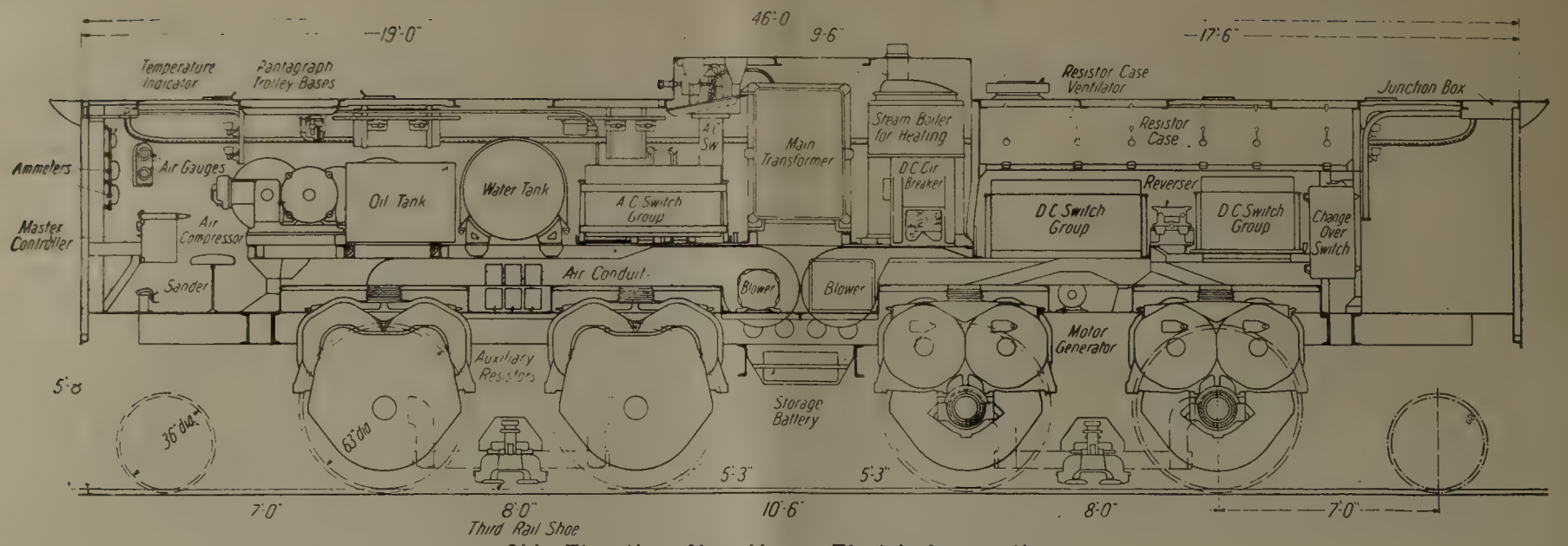
5. The motor armatures are interchangeable with those used on the New York, New Haven & Hartford and the New York, Westchester and Boston motor cars.

6. Finally, eight motors actually cost less than do four having the same aggregate output.

The articulated running gear, adopted for these thirty-six engines is very similar to that used for the 072 type New Haven locomotives (the 072 engines were driven by four motors). A running gear of this type has shown itself to be very "easy running" as far as shock to the equipment in the locomotive cab is concerned, which is one of the reasons why it has been used.

The cab rides on top of semi-eliptic and helical springs in series. This spring arrangement resembles, in general principal at least, that which is employed for and makes riding easy in passenger cars. In general design and ar-

Side View of 8-Motor Articulated Truck Electric Locomotive, N. Y. N. H. & H. R. R.



Side Elevation, New Haven Electric Locomotive.

rangement all of the locomotives are the same but the three bearing the road numbers 073 to 075, are for both alternating and direct-current operation in fast freight and heavy passenger service and are designed to handle a trailing load of 800 tons at a maximum speed of 45 miles per hour.

Interior of Cab Showing Engineer's Operating Equipment, New Haven Locomotive.

When operating on single-phase alternating current they take energy at 11,000 volts and 25 cycles, and on direct current at 650 volts.

Thirty-six of the locomotives which bear the road numbers 076 to 0111 are equipped for 11,000 volt, 25 cycle, alternating-current operation only. They are primarily for fast freight service but will also sometimes haul passenger trains, and are designed to handle a trailing load of 1,500 tons at a maximum speed of 35 miles per hour. All thirty-six of the locomotives are designed to exert a maximum tractive force of 40,000 pounds.

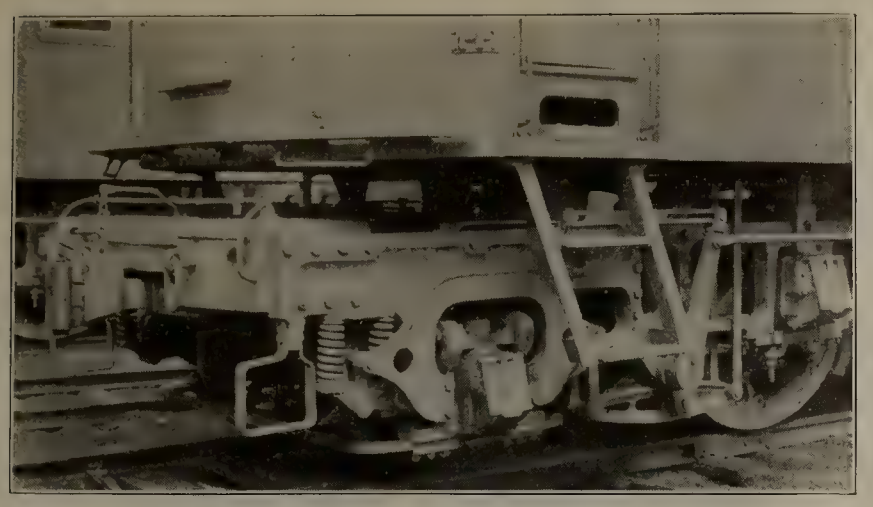
The four pairs of driving wheels and two pairs of small leading wheels are in two groups having outside frames of the bar type. These cast steel frames are four inches wide and are similar to those used in steam locomotive practice. The pulling and buffing strains are transmitted entirely through the truck frames which are braced transversely at the end of the trucks and between the driving axles. The inside faces of the driving pedestals are finished to a taper and are fitted with adjustable wedges. The pedestal binders are cast steel.

The drawbar pull is transmitted from truck to truck by means of a draw bar adjusted to leave a ½ inch maximum clearance between the end ties or bumper guides of the trucks when all the slack is pulled out. The truck cross ties or bumper guiders which are located on trucks at the mid-length of the locomotive, are equipped with spring buffers which assist in transmitting the buffing shocks from truck to truck. The drawbar has a slotted hole in one end. With this arrangement all pulling strains are transmitted through the drawbar and pushing and buffing shocks through the spring buffers, and bumper girders.

Midway between the driving wheels, the bar frame of each truck is braced transversly by a built-up structure on which the truck center pin is mounted. This pin carries no weight, its only function being the cab underframe and to hold the truck in alignment with the cab. The center-pin of one truck is allowed a limited longitudinal movement with reference to the can underframe to relieve the cab frame from pulling and buffing strains.

A two-wheeled truck of the Rushton type with outside journals is arranged under each end of the locomotives and carries the small guide wheels. The Rushton truck is of

Articulated Trucks, New Haven Locomotive.



The Rushton Truck, New Haven Locomotive.

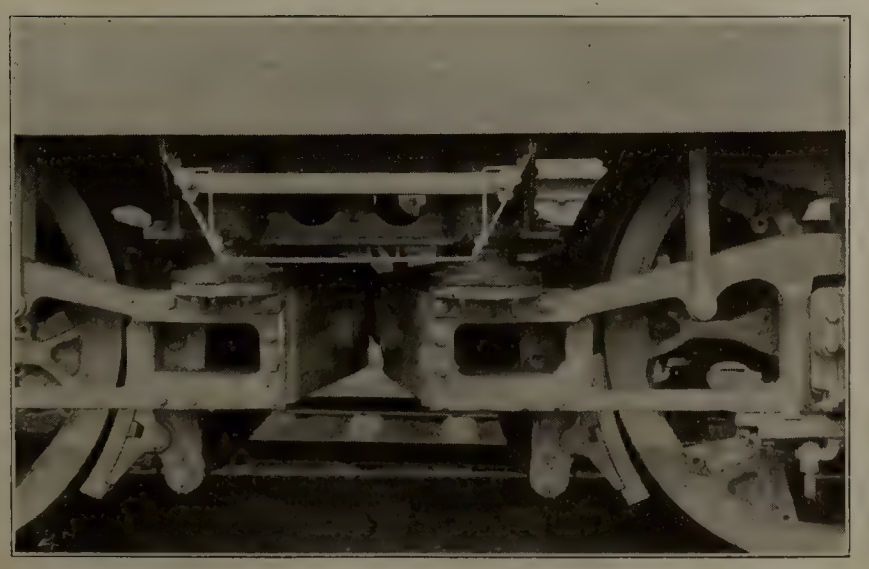
the radial type, its frame being connected to the main truck cross tie by two links which are so arranged in relation to one another that the intersection of their center lines, if they were extended, would intersect on the center line of the locomotive at the correct point for the truck radius-bar pin. This construction was adopted because the motors are so located that it is impossible to place the radius pin at its normal position on the center line.

A radial type draw bar, arranged to receive a housing for a Westinghouse friction draft gear is mounted on each end of the engine. Thurst springs are provided to limit the lateral movement of the draw bar. The coupler shank is supported by a carrier iron which is bolted to the end bumper casting.

Each group of two pairs of driving wheels and a pair of truck wheels is equalized on each side of the locomotive. The springs are of the usual elliptic form and are mounted directly over their respective boxes.

Helical springs support the truck frames at their outer ends. The equalizing beams are of cast steel.

An underframe composed of two 12-inch, steel channel side sills and two trussed center sills support the cab and equipment. The cab covers the whole locomotive and is built of No. 14 steel plate on a bar frame. The cab underframe is supported at four points being at the inner ends of the truck, with their centers eighty-four inches apart transversely, while the other two are located, their centers 34 inches apart transversely, between the truck wheels and the adjacent driving wheels. As this arrangement is duplicated on both trucks, there are four points of support at mid-length placed wide apart transversely and two points near each end, placed comparatively close together. The weight of the cab is transferred to the truck frames through coiled springs, and the spring pocket plungers slide on the frame cross ties when the engine is traversing curves. Thus the cab on the trucks being held in proper alignment with them by the center pins.

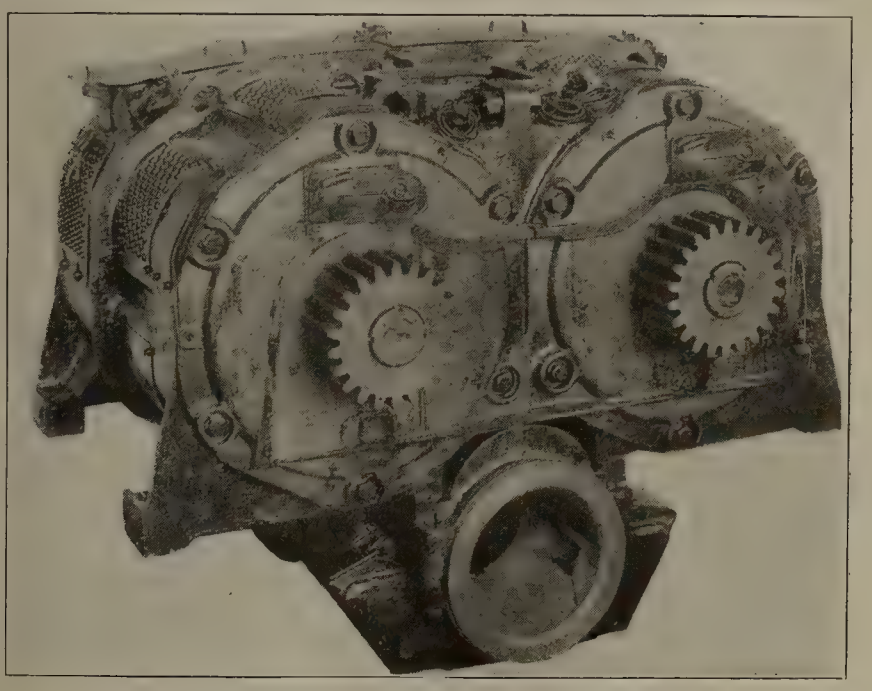


Spring Buffers and Bumping Girders, New Haven Locomotive.

The principal dimensions of all of the locomotives are as follows:

Length between coupler faces	50 ft.
Width over all	10 ft. 3 ins.
Height to top of cab	12 ft. 6 ins.
Height to top of clearstory	13 ft. 10 ins.
Wheel-base, rigid	8 ft.
Wheel-base, total	40 ft. 6 ins.
Driving wheels, diameter, outside	63 ins.
Driving wheels, diameter, centers	56 ins.
Driving journals	7 ins. by 13 ins.
Truck wheels, diameter	36 ins.
Truck journals	6 ins. by 12 ins.
Weight on driving wheels, for a. c.—d. c. engines	182,000 lbs.
Weight, total locomotive, for a. c.—d. c. engines	240,000 lbs.

The motors are grouped together in pairs. The two motors of each pair—a right hand and a left hand motor—are bolted together so as to form a unit. One pair of motors is mounted rigidly on the truck frame over each of the four driving axles. Each pair of motors is provided with two



Two Motor Assembled Pinion End.

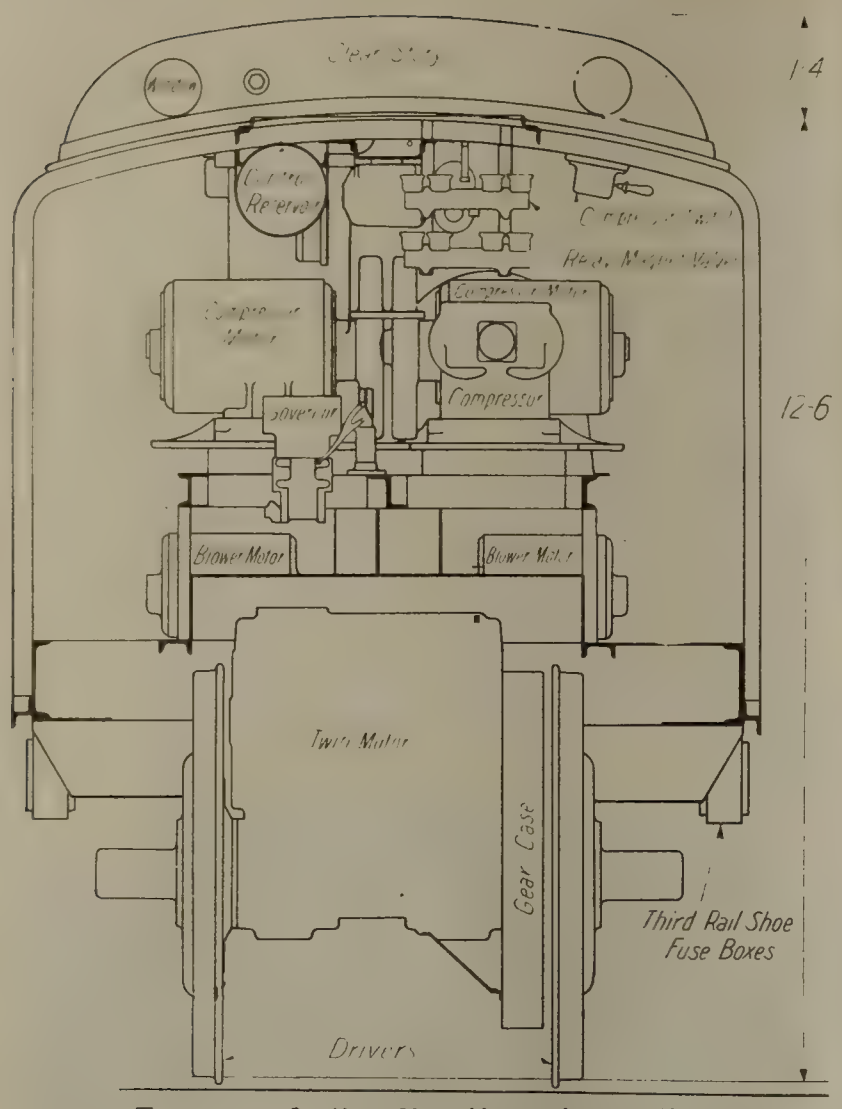
axle bearings which carry a quill which is concentric with and surrounds the axle. A single gear is secured on one end of the quill and into this gear mesh the tow pinions keyed on the motor armature shafts.

Mechanical connection between the quills and the driving wheels is effected through helical springs which are mounted between the driver spokes and the projecting arms provided on each end of the quill. A radial clearance of 1½ inch is provided between the inside of the quill and drive wheel axle so that the drivers are free to follow irregularities in tracks.

This method of mounting relieves the axles of the dead weight of the motors and insures that the operation of the locomotive will be easier on the tracks. A low deck is built over each pair of motors and doors are provided in the decks in such positions that free access to the commutators and armature bearings is afforded.

Flexible leads of ample length to accommodate all movement of the motors relative to the cab extend through insulating bushings in the floor and electrically connect the motors with the control apparatus.

Of the thirty-nine locomotives three are arranged for operation on either alternating current or direct current and these are provided with control equipment that can be used in either service. Therefore the pneumatically-operated control switches work in combination with a transformer and preventive coils when the locomotive is receiving alter-



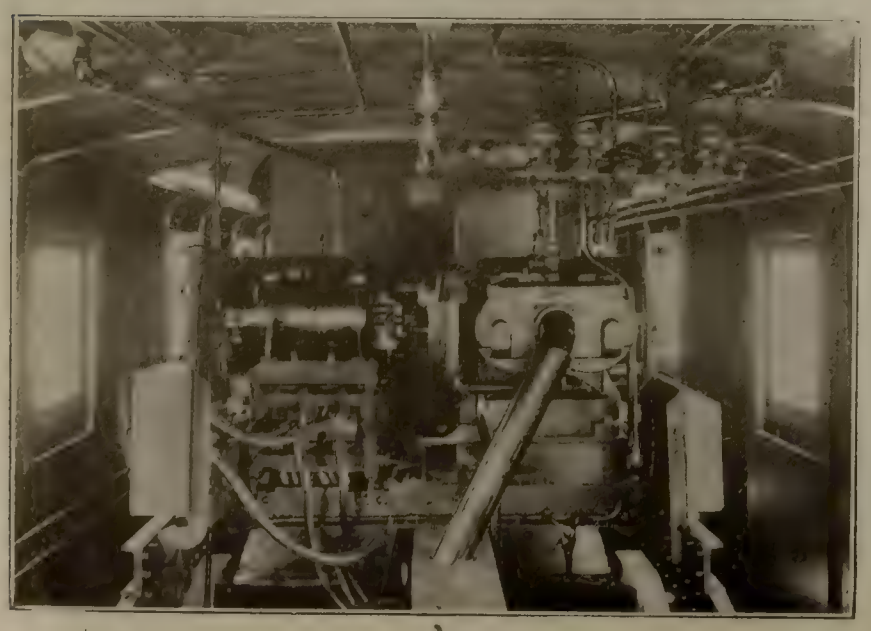
Transverse Section, New Haven Locomotive.

nating current energy and in combination with grid resistors when it is receiving direct current.

Each pair of motors is connected permanently in series. In alternating-current operation the four pairs are connected in multiple and on direct current they may be connected two pairs in series or all four pairs in parallel.

When operating on alternating current from the line at 11,000 volts the energy passes through an oil circuit breaker to the primary of a main transformer and thence to ground. A number of taps are provided on the secondary winding of this main transformer and are connected, through preventive coils, by means of the pneumatically-operated switches to the motor circuits. There are twelve voltage steps on the transformer winding, nine of which are for running points.

The pneumatic switches, used for operation on alternating current are assembled in one group. This group is located close to the transformer. Reversal of the direction of rotation of the motors is effected with two pneumatically-operated drum type reversers. Each reverser is so connected as to handle two pairs of motors. When the locomotives are on direct current the control of the motor is accomplished with two other groups of pneumatically- operated switches which connect the pairs in series and, in parallel, in combination with the resistors. The switches and resistors used for operation on direct current are supported at the center of one end of the locomotive. The switches are arranged in one straight line with the resistors directly above them, so that the connecting leads between switches and resistors are of minimum length.



Interior of Cab, Locomotive Number 076, N. Y. N. H. & H. R. R.

View Looking Down on New Haven Locomotive Number 076.

Two master controllers, one located in each end of the cab, are provided, showing operating equipment. With these the operation of the pneumatically-operated switches and reversers hence the motors can be regulated when a locomotive is running either on alternating current or direct current.

Two Sirocco type blowers, for handling cooling air, each driven by a small alternating-current-direct-current motor are located in the center of the cab directly under the main transformer. These blowers draw their air outside of the locomotive and discharge it through the main transformer, motors and resistors. The equipment is thereby maintained at a moderate temperature even when operating under severe overloads.

A double E. L. air brake equipment is provided on each locomotive. Two compressors, each having a capacity of 50 cubic feet of free air per minute, are mounted within the cab to supply air for the brake and control apparatus.

Brake shoes are applied to all of the driving wheels and separate pairs of cylinders are provided for each group of wheels. The brakes can be applied to one group with a hand wheel located in a cab so that a locomotive can be held while standing in the yards.

An oil burning steam heater plant capable of supplying 800 pounds of steam per hour is installed in the three alternating-direct current locomotives for the heating of passenger trains.

For collecting the current there are two pneumatically operated pantagraph trolleys for use with an overhead wire, and four pneumatically-operated third rail shoes are provided for use in the direct-current zone. There is also a small overhead direct-current shoe-type collector for use at cross-overs. All of the collector devices are arranged so that they are under the control of the engineer at all times from either of the control positions in the locomotive cab.

WHAT RAILROADS NEED.

Intelligent Observation, Properly Applied, Would be of the Greatest Intrinsic Value to the Railroad World.

By W. L. KELLOGG.

He who realizes possibilities and acts on this realization will ultimately become a leader. He who fails in attaining this coveted reputation fails to see or apply, when observed, the concentrated energy of purpose so imperative in the consummating of any plan or the perfecting of any practice. Many observe the natural resources in their immediate vicinity, but there are few who calculate on the possibilities of the things applied, present and future. There are the few who become famous in local circles, and whose names adorn the pages of history, and they are designated or shown up as shrewd financiers; far-sighted business men who are supposed to have possessed more of the desired gray matter than their fellow citizens. The facts are many times the reverse. It is not the extra quantity of gray matter of the brain, but the activity of the same or the faculty of applying intelligent observation. The old saying, that "those who would have riches must save their pennies," is the great secret to financial success when applied. The opportunity is open to all but is embraced by few. The principal reason is that we fail to observe details, and trample under foot the small things which are the atoms of great things possible when gathered together and built into an harmonious whole. The man of the present who would succeed must observe details and take due cognizance of items small in themselves but of much consequence when multiplied by a million.

Systematic grouping, the gathering together of ragged ends, the intelligent organizing of forces and the attention given to details, is what makes possible the immense commercial houses, and gives them supremacy over the small dealer. So, in railway circles, in all branches and in all departments the opportunity offers large dividends to the observer who applies the result of his observation. He is the one who makes phenomenal strides in advancement and whose biography tells he came up from call boy to president.

We observe the locomotive popping. All know that it is wasted energy, and it is allowed and practiced simply because the effect of observation is not figured on, and it would astonish the average railway man if told that the waste from this source alone would be sufficient to pay the salaries of our president and his cabinet. It is a fact, nevertheless. We would be perfectly safe in making the assertion that on an average, firemen waste the amount of their wages every trip; that fifty per cent of the lubricating oil used never reaches a bearing; that a reduction of twenty-five per cent in the cost of operating railway station plants is possible; that a twenty per cent increase in the output of machine shops of the country is possible, if each had applied the improved machines and practical methods of the best equipped and best organized shops; that the cost of delivering coal from cars to tenders can be reduced over fifty per cent if the best appliances were adopted as a standard; that the losses in other ways would in a short time pay the national debt or double the wages of every railroad man, and still leave the stockholders larger dividends than they ever enjoyed before. If these things were observed and the remedy applied, it would be a happy day for railroad owners and their operatives.

Employes frequently report the result of their observation and study to their immediate superior, and I regret to say very often little or no attention is given to them. Seventy-five per cent of such reports are never again heard of and the other twenty-five per cent is transmitted to the next in authority where the same proportion stop, and so on until comparatively few of the many valuable suggestions from experts in humble positions ever reach the general officers who have authority to authorize action to be taken on valuable suggestions. Incompetency to judge the value of a suggestion or jealousy on the part of a subordinate officer often prevents the growth of valuable ideas. There should be an easier road to haul valuable ideas over, and a monetary value should be placed upon them.

The foregoing is in the abstract, and represents the thoughts and actions of nearly all railway employes. They figure possible savings in a general way so that many times results are in the abstract, a conglomeration of words and figures which never repay the writer for the cost of compiling the figures, the result being nothing and the effort unsatisfactory. We need more examples in the concrete. They mean more practical illustrations of devices and appliances and demonstration of theories. The result should be published.

Let us get up an excursion party of railroad men, and make a transcontinental tour of inspection, not for the purpose of finding fault with existing circumstances, but to improve them. On this trip we will not be particular to note whether the outer line of the ballast is parallel with the rails or if the brush is all burned off the right of way, or whether there is dirty waste lying around in obscure corners or whether there are defective gutters on material sheds. Our purpose will be rather to observe the possibilities of applying those things which would be of intrinsic value if applied. Starting on our journey through the suburbs of a metropolis, thronged with vehicles and pedestrians, our progress is necessarily slow and fraught with danger. This produces a state of vexation, and we stop to consider the situation with a view of determining what might be done to prevent the delay and loss to the company. We find six flagmen imperfectly protecting the crossings, and their wages aggregate $9.00 per day. One man in a tower can operate pneumatic gates at a cost of $3.00 per day, and there will be a saving of $6.00 a day to the company or a sum that will equal six per cent on the cost of a plant worth $36,500. Would it pay? Many companies think so, while others say that they cannot afford it. Is the latter true?

Traveling on, we visit the shops of a small road owning 100 engines. We are informed by the officials in charge that one-third of this power is not up to date, but they cannot afford to purchase new. Let us consider the matter and see if they can or cannot afford such expenditure. Their performance sheet shows that each of these engines cost two cents per mile more than better designed engines hauling greater tonnage over the same territory. Two cents per mile in itself is a small item and we view it with complacency. It will not even buy a sack of peanuts or a pound of waste, but when we consider that this poor class of power annually makes about one and three-quarter million miles, the two cents per mile assumes greater proportions, and when we take into account the sum of $35,640 as a dead loss every year, we are unable to concur in the opinion of these officials that they cannot afford to purchase new power. It is safe to say that every large railway in the country has hundreds of such engines, many of which, all things considered, are run at a greater loss than two times two cents per mile. When there is a difference of two or more cents per mile in the cost of operating a locomotive there is something radically wrong and this difference will buy new power; it will purchase the best skilled labor in the market; it will buy improved machinery; it will furnish the best quality of coal or a water that will not ruin the boilers. This discrepancy should not exist, but if it does some one is at fault; some one needs retiring that room can be made for a more progressive man. We should remember that the dividends are the mills of miles run, our dividends, as well as the stock owners.

At another point we view a well equipped coal chute. There was the usual incline and covered chute but it was operated differently. We did not see the customary switch engine taking run after run up the incline and fail, then cut off two cars and run the balance up while three switchmen stand at the bottom swearing at the engineer because another, under more favorable conditions, once put up the number of cars he first failed with. At this station two men are constantly employed, and they unload from hopper bottom cars all the coal used. They use a donkey engine and a cable to haul the loaded cars up and let the empties down.

These two men attend to the dumping of chutes and accounting for the coal, and the cost of handling is six cents per ton less than at the average coaling station. Six cents per ton of itself seems to us a small thing, but let us consider if it is worth saving. Many railway systems use five hundred thousand tons of coal per annum, and six cents saved on the handling of this quantity will amount to $30,000 or the interest on $500,000 at six per cent for one year. This amount would equip the largest system with modern coaling stations. In addition, we will make the assertion without fear of successful contradiction, that the consequential cost of coaling engines from the ground or from bins with buckets and cranes, in considering the deleterious actions of the elements on the coal, the mixing it with sand and cinders in getting it from the ground; the burning of a ton of coal on many engines while waiting turn to have six tons shoveled on and the average of from one to two hours for engines held out in the yard when they should be in the house receiving necessary repairs will cost not less than twenty cents each on every ton of coal consumed. Furthermore, it is possible for railroads to contract the coaling of engines at present prices for five years to men who would make the improvements necessary, and at the end of that period, make the company a present of the plant. So we conclude, if private speculators can afford to put up modern coaling stations for the difference in cost per ton railways can better afford it when many other consequential savings are possible.

We next visited the shops of a leading line, and were surprised to find that although their rolling stock and equipment were first class and they had some superb limited trains, their shops were inadequate, badly arranged, antiquated machinery and the general surroundings stamped with the stencil of twenty years ago. At that time they were considered well arranged and up to the present have rested on their laurels of two decades past and gone to strengthen the assumption that they were still up to date. Let us make a few observations. On entering we observe two men operating single ended axle lathes, and we figure $2.50 per day lost; we note there are neither drop pits nor traveling cranes and we put down $10 per day lost. The remainder of the machinery examined convinced us that there was a further loss of $9 a day by continuing in service a number of machines which might have been replaced with something more modern. We found the hand tools in the tool room in poor condition. Men carried tallow candles and walked one hundred yards to the store room every time they required a new one. After leaving the shops and noting the many inconveniences, we tabulated the apparent losses, and found a total of $57 per day. New shops have been planned for years. Each resident engineer had submitted plans but it was never considered of sufficient importance to warrant the expenditure. Let us see, $57 per day in one year's time will amount to $20,805 which is sufficient to pay the interest on a sum that will build and equip a modern shop, and the daily losses saved will pay the interest on the amount. Would it pay?

At a busy division point where a turn table is required to turn locomotives, it is safe to say that it takes the time of two men, day and night, to operate the table, at a cost of at least $8.00 per day. This will amount to $240 per month and $2,888 per year. If this expense can be reduced one-half, or still more by having a hostler operate the table, it would produce a saving of $1,440 per year, which at six per cent, represents an investment of $24,000, enough to equip all the tables on a trunk line with power to turn them. These calculations, not including cost of power which is a secondary consideration, are made possible with the various kinds of motors to be had.

Another point which came under our notice was the manner of washing boilers, and in only one instance did we think any degree of perfection was reached. This boiler washing plant seemed complete in all of its details. A two-inch pipe placed overhead, led entirely around the house and into this steam from all locomotives was blown and carried to a condenser. Steam from other sources exhausted into this pipe. The water was filtered and led to a ten thousand gallon hot well. The hot water from the jet condenser also falls into this hot well and there is sufficient water to wash out and fill up all locomotive boilers and furnish the feed water for the shop boilers. With this system, and having connections for locomotive domes, it is possible to transmit steam from live engines to dead ones. This, in itself will make it possible to get up steam in a short time and it will greatly reduce the expense of firing up. In an ordinary shop 50,000 gallons of hot water is used daily, and the cost of raising the temperature from 60 to 200 degrees is approximately $25 per day. This plan not only saves $25 per day, by condensing the exhaust steam, but it purifies the water, reduces the time required to get engines ready and saves the stay bolts from breaking. The direct saving alone will pay the interest on an investment of $152,000. Such a plant will cost about $300 and very little for maintenance. Would it pay? It certainly would but there are very few such plants to be found on our so-called up to date railroads.

We found but few roads where the officials were thoroughly alive to the importance of the fuel system. Some officers could talk for hours about oil and tell how much they have saved, but if they had saved the whole, it would not amount to one-tenth the cost of fuel. The best authorities tell us that but ten per cent of the fuel consumed by locomotives is effective in pulling cars. The balance must be lost. When we consider that from forty to sixty per cent of the cost of operating locomotives is spent for fuel, we marvel much. We have heard of private individuals, experts in their line, offering to equip engines with coal saving devices and devote their entire time to this purpose, taking for their pay a small percentage of the savings. It occurs to us that railway companies should use more energy in this direction.

There is also the question of feed water for our locomotives. Millions of dollars are expended annually in renewing flues and fire boxes on account of poor water; every conceivable mixture of boiler compound has been tried without any substantial benefits. A system of reservoirs to hold rain water where good water cannot be obtained is the only sure remedy.

In the mechanical line of locomotive equipments there are many devices and attachments that are important if we compute on the saving of the better and the losses of the poorer. One of the most important that will bear investigation is the style and size of injector used. It is safe to assume that the question of boiler feed is the most important factor in connection with economy in fuel that we have to deal with. Are your injectors of the best design and size suitable to the requirements? Are they lifting injectors, capable of feeding warm water with the greatest range necessary to varying conditions or are they non-lifting out of reach and sight of the operator which of itself is not conducive to the best results that should be attained if we figure on the saving of the black diamonds which we feed into the capacious

mouth of the modern battleship. According to data compiled from tests made on some of the most important trunk lines, locomotives equipped with ancient injectors cost enough more for fuel each three thousand miles run to purchase modern injectors. Would it pay?

These illustrations might be multiplied by hundreds of thousands. They are things that are known to exist and are daily and weekly commented upon by those who are intimately connected with the operation and maintenance of railways, while the exact conditions are not always known, it is usually understood that the abstract may become concrete with but little further investigation. But why the original condition and why is the remedy delayed? Is it the fault of patient or physician? Our answer would be that it is neither of these but the lack of means to procure the necessary drugs. In most cases our methods and avenues of communication and our censors of utterance are largely responsible. Departmental lines over which we fear to step are too closely drawn for our common good. The lack of expression and praise of a duty well performed, which would influence further effort as well as the checking up of diverse methods would be sure to quicken the senses of those responsible for their inattention and are equally important. Let us broaden the path and extend the sphere of the monthly and annual inspection trips. Let us make more experiments; let us call in the expert of the roadway, the bridge builder, the track walker, the engine inspector, the engineer and fireman, the conductor and brakeman and all others intimately acquainted with their work in hand, and extract from them the value of an intelligent observation. Let us brighten our own perceptive possibilities by the training of that sense. Let us show up the faults as they exist and correct the evils when found and we will all become of greater intrinsic value.—*Pere Marquette Monthly Magazine.*

PORTABLE CAR AXLE GRINDER.

A device for facilitating the grinding of roughened journals on car axles at points where proper machinery is not available, has been patented by W. F. Cremean, general car foreman of the Hocking Valley Ry. at Logan, Ohio. Two views of the grinder are shown herewith.

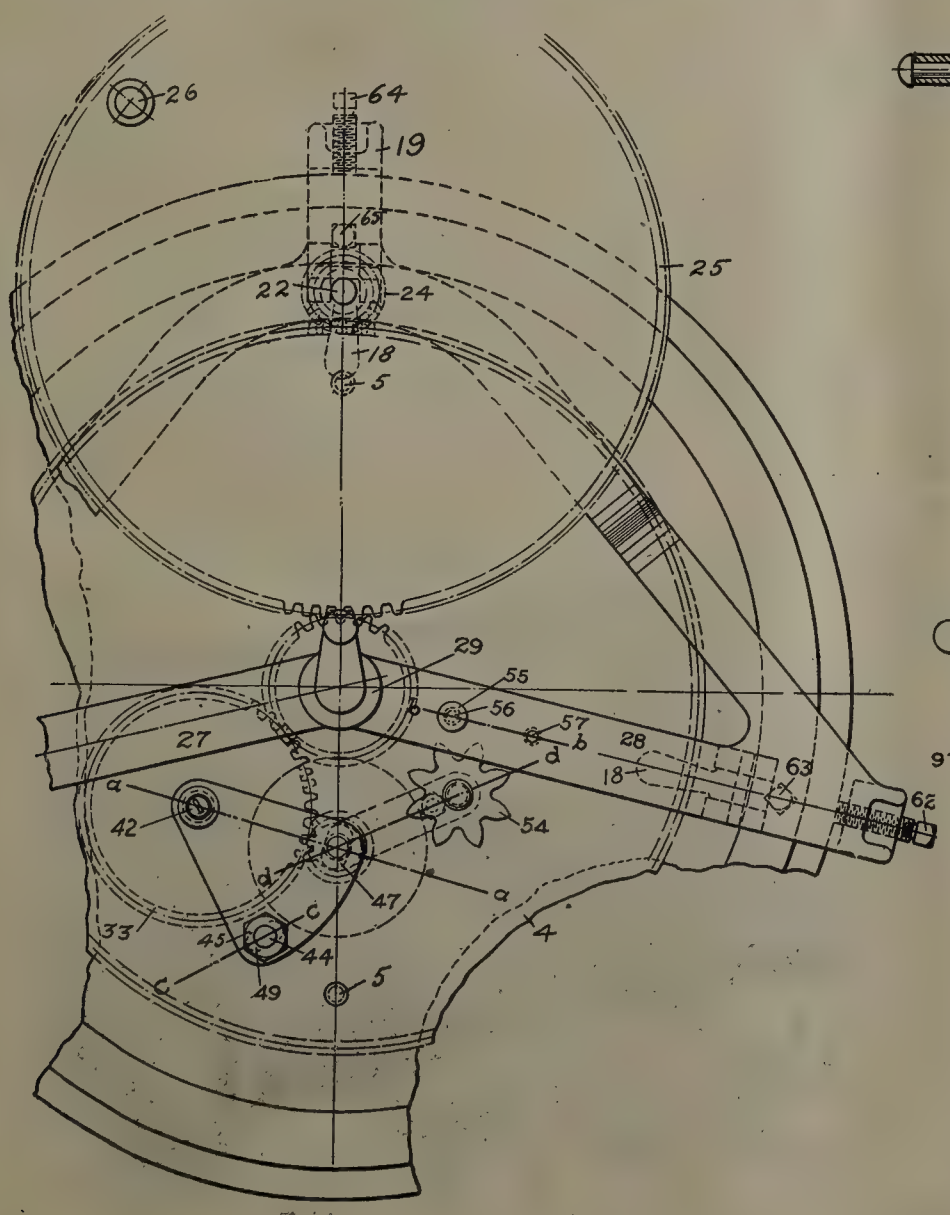
The advantages of this machine as set forth in the patent articles are that its use obviates the necessity of sending a rough axle or shaft to a machine shop to be trued up, and saves in both expense and time in the repairing of axles or other cylindrical parts which have become unfit for service. Further advantages lie in the ease with which the machine may be transported, and mounted upon large or unwieldy shafts or machine parts which would otherwise have to be handled and ground by large and expensive grinding apparatus.

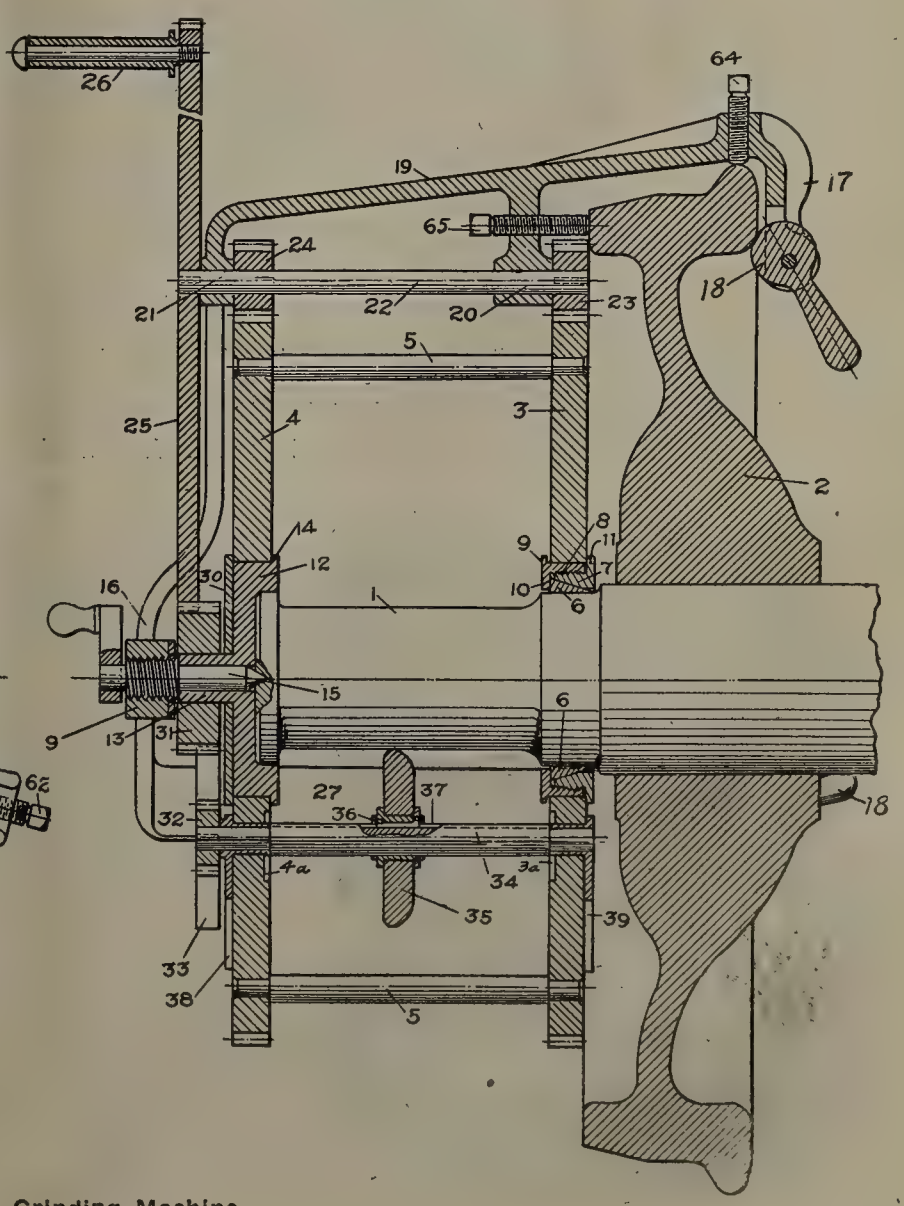
In the drawings 1 represents a car axle, and 2 is a car wheel mounted upon it.

3 and 4 are gears which are securely fastened together in alinement and fixed relative position by the shouldered rivets 5—5, forming a revoluble frame.

6—6 are wedges which occupy slots in the externally threaded ring 7 for the purpose of clamping the axle or member to be ground and for alining the gear 3 relative to it.

8 is an internally threaded ring which screws over the ring 7, and drives the wedges 6—6 evenly into their slots in it and against the axle. The outer surface of the ring 8 forms a bearing on which revolves gear 3. Ring 8 has an outwardly projecting flange 9 which forms a retaining shoulder for the gear 3, and an inwardly projecting flange 10 which presses the wedges 6—6 into place. Ring 7 has an outwardly projecting flange 11 which forms the other retaining shoulder for gear 3. Both rings 7 and 8 are bored somewhat larger than the nominal diameter of the axle upon which they are





Portable Car Axle Grinding Machine.

mounted, to accommodate slight variations in size, the use of the wedges 6—6 permitting such an arrangement.

On the outer end of the journal which is to be trued is placed the sleeve 12 which is provided with a trunnion-like extension 13. The outer surface of the sleeve 12 forms a bearing on which revolves the gear 4. A retaining flange 14 projects from sleeve 12. Projecting axially through and closely centered with the trunnion 13 of sleeve 12 is a pin 15, formed at one end into a lathe center for the purpose of entering the countersunk hole in the center of the end of the axle.

The operation of the machine will be readily understood. Although it is shown equipped with a crank for hand turning, it can be arranged to run with a portable air or electric motor.

Fig. 4—Grounding Switch for Short Circuiting Third Rail, Penn. Locomotive.

FIELD CONTROL OF THE PENNSYLVANIA ELECTRIC LOCOMOTIVES.

An aggregate delay of but thirteen minutes, chargeable to electrical apparatus on thirty-three locomotives for a year is said to be the performance of the Westinghouse locomotives in the service of the Pennsylvania Tunnel and Terminal Co., operating out of New York City. During the year 1911 the mileage given below was made by these locomotives:

Total locomotive miles	909,238
Maximum miles per locomotive	56,000
Average mileage per locomotive	25,975

The control of these locomotives is of interest not only because of this excellent maintenance record, but also because of several hundred features described below, that are incorporated in it.

Field control is used. In the early days of electrical traction the method of controlling motors by shunting their fields was applied, but finally abandoned, due to the poor operation of the pioneer motors. Later commutating-pole railway motors for field control were successfully developed. The New York, New Haven and Hartford used shunted field control for direct-current operation on its original locomotives. When the Pennsylvania locomotives were constructed a special type field control was developed for controlling the large 2,000 h. p. commutating pole motors which drive them.

The field of each Pennsylvania locomotive motor is divided into two parts and in both series and parallel running there are two running points. One with maximum or full field and the other with normal or half field in circuit. In each case there are two transition positions between full field and normal field positions in which resistance is shunted across the motor fields. Thus these locomotives have four running positions.

Each locomotive consists of two units, each complete in itself and interchangeable, so that at any time either half of any locomotive may be coupled to any other half locomotive.

In Figures 1 and 2 are shown respectively the master controller and the unit switch group for controlling the motors. The handle of the master controller is arranged

Fig. 1.—Master Controller, Unit Switch System, Penn. Locomotive.

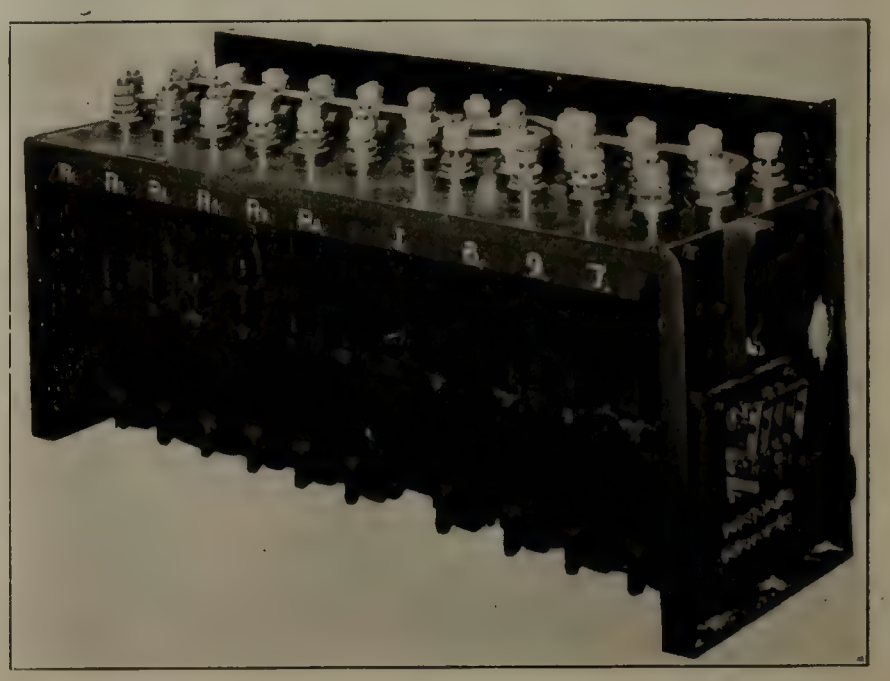


Fig. 2.—Switch Group for Field Control of Penn. Locomotive.

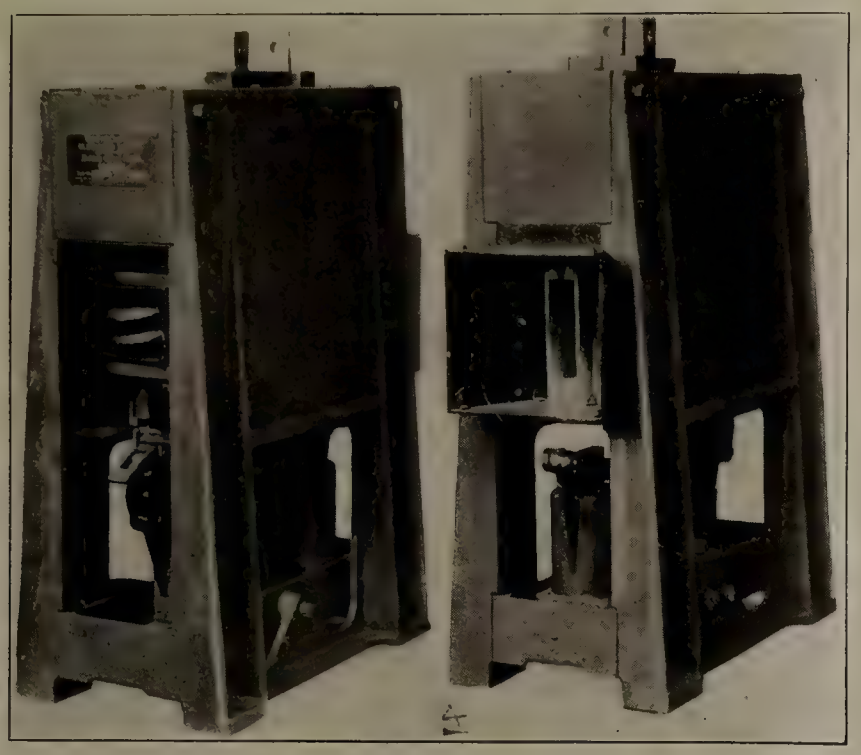


Fig. 3.—Front and Rear Views of Automatic Circuit Breaker, Penn. Locomotive.

to have but a comparatively small amount of travel, similar to that of a steam locomotive throttle; however, by means of a gear connection, this small movement is multiplied in transmission to the controller drum.

An extremely quick-acting circuit-breaker is used. By means of its size it operates differently from the ordinary line switch or circuit-breaker, in that it can be tripped without first releasing the air from the main cylinder. By its quick action the extent of damage from short circuit is greatly decreased. Figure 3 shows this main circuit-breaker which is of high capacity and which may be opened and closed by opening and closing the low voltage circuit, which leads to the magnet valve that admits compressed air to the operating cylinder, or it may be operated automatically by means of a magnetic trip. The motor current passes through the coil of this tripping magnet and if the current through the circuit-breaker becomes higher than that for which the breaker is adjusted the plunger lifts and striking against the trip, causes the breaker to open. The movement of the main contact when opening and closing is the same as in Westinghouse unit switches. The operating mechanism is different, the movable contact arm not being connected directly to the piston rod, but to the upper end of a guide rod operated by a vertical movement of this rod which is connected through a system of levers to the piston of the operating cylinder on one side and to the overload device on the other side, through a tripping lever.

These circuit-breakers are enclosed in iron cases. The arc chute in which the main contacts are contained is open so as to give plenty of room for the copper gases to vent when the breaker opens from excessive current. Powerful blow-out magnets are located on each side of the arc chute opposite the contacts. The circuit-breakers are located one on each locomotive unit, near the cab partition adjacent to the switch groups, the arc chute venting toward the center passageway between switch groups.

As an emergency provision, in order to kill the third rail for any reason, a short circuiting or grounding switch is placed on each half of the locomotive. It is operated by a pull lever projecting through the floor on the left side of cab. The closing of this switch unprotected by fuses causes a dead ground which is ample to trip the breakers at the sub-station and thereby cut off power.

Personals

T. W. Callahan has been appointed master mechanic of the Mesabi division of the Great Northern and Nels Osgard has been assigned to the Superior division as master mechanic. Both have headquarters at Superior, Wis.

W. E. Maxfield succeeds C. E. Boss as master mechanic of the Texas & Pacific with office at Big Springs, Texas.

R. E. Bell has been appointed master mechanic of the Gulf Colorado & Santa Fe with office at Galveston, Tex. Mr. Bell was formerly general foreman at the same place.

W. L. Kellogg, superintendent of motive power of the Pere Marquette, has had his headquarters transferred from Detroit to Grand Rapids, Mich. Geo. Hilferink succeeds W. W. Scott as shop superintendent of the Pere Marquette at Saginaw, Mich. W. A. Chamberlin succeeds F. C. Pickard as master mechanic at Saginaw.

G. W. Taylor has resigned as superintendent of motive power of the San Antonio & Aransas Pass.

B. A. Eldridge succeeds Ed. P. Gray as general foreman of the Atchison, Topeka & Santa Fe at Arkansas City, Ark.

J. B. Stewart has been appointed master mechanic of the Texas, Oklahoma & Gulf with office at Bismark, Okla. He succeeds H. Reed.

J. J. Maginn succeeds G. W. Reeve as general foreman of shop of the Cincinnati Northern with office at Van Wert, O.

G. H. Bussing has been appointed superintendent of motive power and equipment of the Mexico North-Western with office at Madera, Chih., Mexico. He succeeds J. E. Hickey.

T. H. Nanney has been appointed general foreman of the Buffalo & Susquehanna with office at Galeton, Pa. W. E. Farris succeeds B. D. Folwell as purchasing agent with office at Buffalo, N. Y.

S. H. Lee succeeds L. C. Bruggeman as foreman of locomotive repair of the Chicago, St. Paul, Minneapolis & Omaha. His office is at E. St. Paul, Minn.

A. Dibolt has been appointed foreman of car repairs of the Hocking Valley with headquarters at Columbus, O. He succeeds C. S. Stark.

H. O. Inglish succeeds F. A. Scott as master mechanic of the Texas City Terminal at Texas City, Tex.

F. S. Cuthbert has been appointed master mechanic of the Gulf, Florida & Alabama at Pensacola, Fla.

J. S. Alport has been appointed master mechanic at Boyne City, Mich., on the Boyne City, Gaylord & Alpena.

N. J. O'Connor succeeds H. W. Bleeze as master mechanic of the Florence & Cripple Creek. His office is at Colorado Springs, Colo.

E. D. Lide has been appointed master mechanic of the Carolina & North-Western to succeed J. S. Booth. His office is at Hickory, N. C. N. J. Johnson succeeds W. D. Hurt as car foreman at the same place.

R. Henderson is now purchasing agent of the Kentucky & Tennessee. His office is at Stearns, Ky.

A. E. Cox was appointed general storekeeper on October 1 for all lines of the Canadian Northern west of Port Arthur, with headquarters at Winnipeg, Man. He was formerly storekeeper.

F. S. Brown has been appointed acting mechanical engineer of the Erie with headquarters at Meadville, Pa. A. Trautman succeeds P. J. O'Dea as shop superintendent at Meadville.

F. Hopper has been appointed master mechanic of the Chicago, Rock Island & Pacific at Estherville, Ia.

H. A. Grund has been appointed master mechanic of the Minneapolis & Rainy River with office at Deer River, Minn.

John Barry has been appointed purchasing agent of the Forest City & Gettysburg with office in the Frick Bldg., Pittsburgh, Pa.

F. F. Branson succeeds Lewis Drane as purchasing agent of the Mississippi Central with office at Hattiesburg, Miss.

J. Frank Haig has been appointed purchasing agent of the Baltimore & Sparrows Point at Philadelphia, Pa.

E. C. Walsh succeeds F. J. Hunton as purchasing agent of the Fort Worth Belt. His office is at the Stock Yards Station, Fort Worth, Tex.

H. M. Hutton has been appointed master mechanic of the Baltimore & Ohio with headquarters at Grafton, W. Va., succeeding B. H. Hawkins, resigned. P. Coniff has been appointed assistant shop superintendent of the Mount Clare shop, Baltimore, Md.

J. F. Hill has been promoted to master mechanic of the Wheeling & Lake Erie, succeeding J. E. O'Hearne, who recently went to the Chicago & Alton. Mr. Hill's office is at Brewster, O.

F. Slater, formerly master mechanic for the Chicago & North Western at Escanaba, Mich., has been transferred to Kaukana, Wis., vice W. Hutchinson. E. Becker succeeds Mr. Slater at Escanaba and E. Schultz succeeds Mr. Becker at Green Bay, Wis. C. McClanathan succeeds F. Ehredt as shop foreman at West Chicago and T. J. Stocks succeeds W. W. Hoffman as shop foreman at Janesville, Wis.

R. T. Davison succeeds E. E. Backus as purchasing agent of the Vera Cruz Terminal with office at Vera Cruz, V. C.

John Stroud has been appointed general foreman of the car department of the Santa Fe at Albuquerque, N. M. He succeeds J. M. Sutherland.

G. P. Kempf.

G. P. Kempf has been appointed engineer of tests of the Chicago, Milwaukee & St. Paul, succeeding R. L. Morrison, with office at Milwaukee. Mr. Kempf was born May 20, 1881, at Victor, Iowa, and was educated in the public schools of that place. In 1903 he completed the mechanical engineering course at Iowa State College of Ames, Iowa, and shortly after entered the Dubuque, Ia., shop of the C., M. & St. P. as a special apprentice. After completing his apprenticeship, he was employed in the office of the mechanical engineer, making a specialty of locomotive road tests and power plant work and continued in this position until his recent appointment.

New Books

FREIGHT TERMINALS AND TRAINS. By John A. Droege; 5¾ x 9; cloth, 465 pages. Published by the McGraw-Hill Book Co., 239 West 39th street, New York. Price $5.00.

This book is in a sense a revision of "Yards and Terminals" published in 1906 by the Railway Age Gazette. The treatment of the subject, however, is a considerably broader one. The work is a very complete and exhaustive treatise on the entire subject of rail freight transportation in the United States and Canada and it includes, probably for purposes of comparison, a short description of English methods. Problems of the operating department are of course given prominence. Engineering department officers, however, will be interested in the author's discussion of yard and terminal layouts; and officers of the mechanical department find their work touched upon in the chapters on engine houses, coaling stations, and on the duties of the engine house foreman. The author has added masterful touches to the book through the assistance of Chas. B. Breed, associate professor of civil engineering in the Massachusetts Institute of Technology, who wrote a chapter on "Track and Maintenance Details"; and that of Wm. J. Cunningham, assistant professor of transportation, of Harvard University, who wrote a chapter on "British Freight Service." There are few students of railway transportation or, indeed, experienced railway officers who will not find this book of very considerable assistance. It seems to supply information which has long been needed in just this form.

New Literature

The Anderson Brake Adjuster Co., of Omaha, Neb., has published a folder dealing with the Anderson brake adjuster. This adjuster eliminates the human factor as regards negligence in adjusting brakes and maintains them at a maximum efficiency.

* * *

Supplement 2 to the catalogue of the Moore Patent Car Co., St. Paul, Minn., gives results of some tests made on cars of the Duluth & Iron Range R. R. equipped with the Moore system of refrigeration, heating and ventilation. Some very interesting results are shown.

* * *

The "herringbone gear" has been growing in popular favor during the past few years and a recent pamphlet of The Earle Gear & Machine Co. of Philadelphia contains considerable of interest concerning this subject. This firm specializes in herringbone gears but manufactures other gears as well.

* * *

"Pipe and Nipple Threading Machinery" is the title of a booklet which has been distributed by the Landis Machine Co., Waynesboro, Pa. Descriptions of the Landis long life die are given together with a catalog of the various threading machines in which it is used.

* * *

"Man—Without Tools He Is Nothing; With Tools He Is All," is the foreword of a handsome catalog recently issued by the Armstrong Bros. Tool Co. of Chicago. Thereafter is given the complete line of tools handled by this firm, which include tool holders, wrenches, ratchet drills, drill sockets, dogs, high speed steel and grinding machines. The catalog is a very pleasing one.

* * *

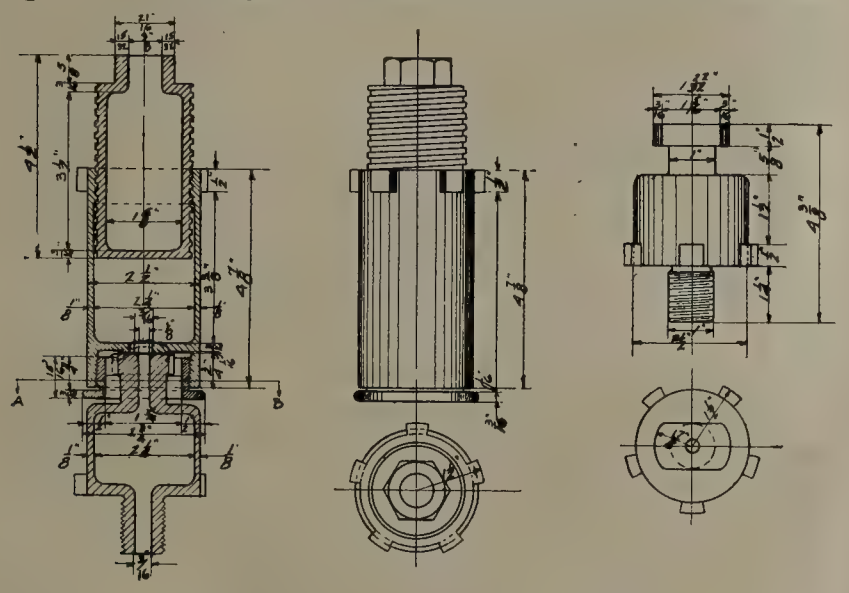
The New Britain Machine Co., of New Britain, has issued a catalog dealing with "New Britain" automatic multiple spindle chucking machine for machining castings, forgings and second operation rod work. The illustrations are clear, the print is large and readable and the whole is in very good taste and worthy of the machine shown.

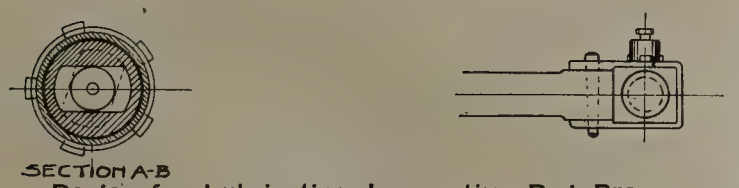
Among The Manufacturers

LOCOMOTIVE GREASER.

A device for the purpose of a betterment of the methods now in use for lubricating the rod brasses of locomotives has been placed on the market by Smith, Haller & Co., 507 Jackson Boulevard, Chicago, Ill.

As shown in the drawing the device consists of a small grease cup for permanent attachment to the rod brass, and an independent greaser which is attached to the cup by a quarter turn. The greaser is fitted with a screw plug for the purpose of forcing the grease into the cup. At terminals the man designated for the purpose makes the rounds of the engines with the greaser filling each cup by screwing down





Device for Lubricating Locomotive Rod Brasser.

the plug. It should also be his duty to see that the engine crew is furnished with a full greaser before the engine leaves the terminal. The greaser furnished the engine crew is in the nature of an emergency appliance, as the cups should make the division run without refilling. In case, however, it does become necessary to refill the cups, it can be done by means of the greaser illustrated, in a minimum amount of time. By this means the expense of lubrication is reduced and the introduction of foreign matter is avoided.

DRILL TESTS.

A series of interesting tests were recently made at the University of Cincinnati on a "Standard" ½-inch, 110-volt portable electric drill manufactured by the Standard Electric Tool Co., of Cincinnati, O. The tests were made by placing the drill in an upright position under the spindle of an upright drill press, the press feed being used to force the drill against the work. The results of the test are as follows. The watts in the first test varied owing to the changing load on the drill as the feed was too rapid to be regular:

Test No.	Volts.	Watts.	Size of Drill.	Depth of Hole.	Time in Seconds.	Material.
1	95		½ in.	2 in.	52	Steel
2	110	450	½ in.	2 in.	67	Steel
3	120	650	½ in.	2 in.	35	Steel

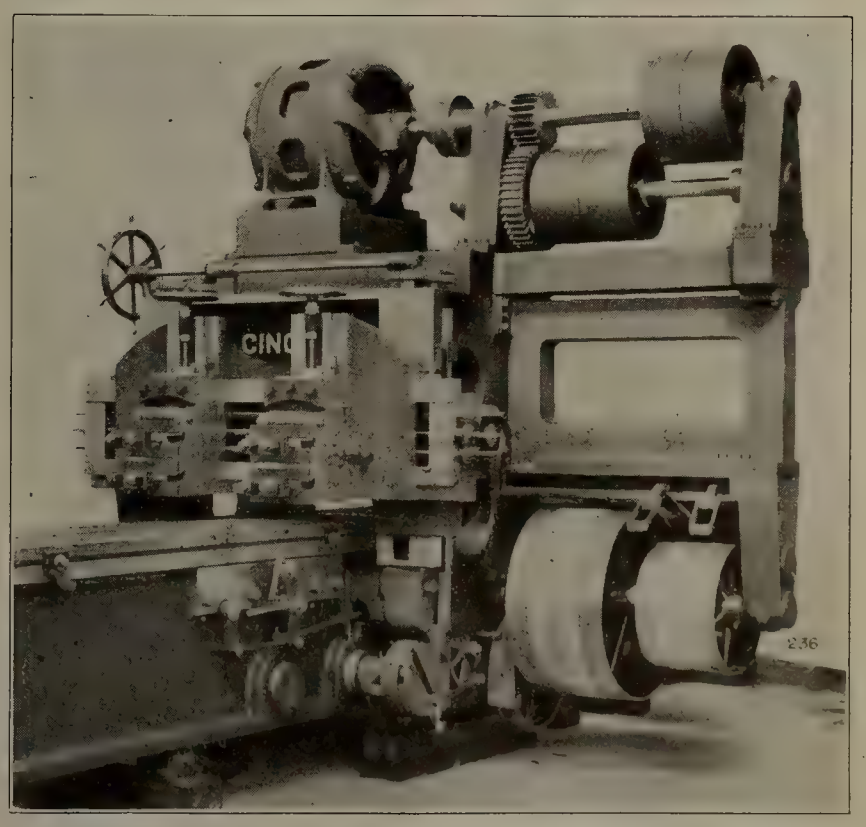
Test No. 1 was made at a low voltage and the drill was worked extraordinarily hard. Test No. 3 was made at an abnormally high voltage and the drill again worked much harder than it would ever be possible for it to be worked in actual practice. In neither of above cases was the drill damaged in the least, either by the high mechanical strains or by over heating.

Test No. 2 was made under normal conditions, both as to voltage and load applied to the machine, approximating as nearly as possible to operating conditions where the tool would be in continuous service. The time required to drill a ½-in. hole through 2-in. of steel is quite noteworthy in the above test, as it shows at even the reduced pressure of 95 volts it can be made to drill at the rate of 1-in. in 26 seconds.

FROG AND SWITCH PLANER.

The Cincinnati Planer Co., of Cincinnati, O., is adding to its line the 36-inch frog and switch planer shown in the illustration. The driving pulleys are of aluminum alloy, 34 inches in diameter, and the machine is driven by two 4-inch belts, the counter shaft being mounted on top of the housings. A 50-h. p. motor is used for driving the machine. A heavy cast frame is fitted between the upper and lower bearings and is also fastened to the housings, so that there can be no spring to the shafts or bearings under heavy cuts. The bed is braced throughout by box girders and is made with four walls between the housings, where the greatest strain is produced. The vees of the bed are furnished with forced feed lubrication by a pump.

The table is 32 inches wide, has an inside bearing on the bed its entire length, overcoming the pressure of heavy side cuts, and adjustable steel gibs are provided on each side to prevent lifting. The cross rail is 20 inches wide and has a deep ribbed box brace on the back for increased stiffness. In addition to the usual outside set of clamps it is secured to the housings by an extra set of clamps on the inside, making a very rigid construction.



Cincinnati Frog and Switch Planer.

The heads have automatic cross and vertical feeds, and are made right and left to bring them close together. The saddle and harp are made in one piece without swivel, and have a bearing on the rail of 25 inches. The shifting mechanism is provided with a safety locking device, which prevents the table from starting except at the will of the operator. Levers are so arranged that the machine can be operated from either side. The rack and gearing are made from solid crucible steel, and designed to withstand the enormous strain incident to frog and switch work. The bull wheel and rack are unusually wide and coarse, having 12-inch face, 1½ pitch.

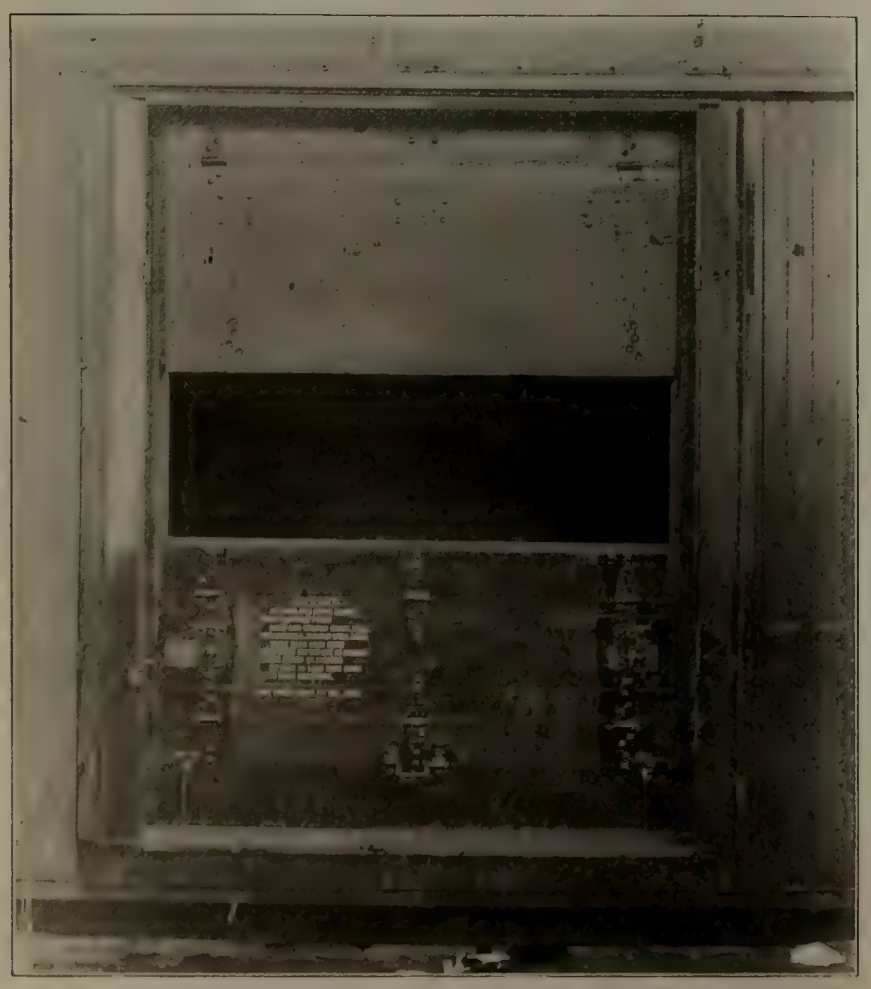
Combination Door Closed.

NEW COMBINATION FREIGHT CAR DOOR.

The door, illustrated herewith, is designed to take the place of the outside door as well as the grain and coal door. It slides along the inside of the car so that there is no possible chance for it to drop out and be lost. The door will handle all kinds of commodities, grain, coal, merchandise and lumber. It has three openings. The upper door being used to load grain, the lower door, which is 31 inches high and the entire width of the car, is used for unloading grain, coal, etc. The middle door is 24 inches wide and the entire width of the car door and is used in unloading grain and coal on team track. In most cases the entire car load can be handled through the smaller doors but if it is desired to have the doorway of the car clear the door can be slid back like any outside door, as it is suspended on rollers which travel on an overhead track which is fastened to the plate of the car.

The door, when closed, rests against the inside surface of the car, thus adding strength to the car door posts and preventing them from bulging. The small doors swing outward so that the pressure of freight bearing against the doors will not prevent them from being opened. The movable post fastened to the car door posts serves to lock the three smaller doors and makes the joints at both ends rain tight and burglar proof. The solid and simple construction of this door should make it last the life of the car. Packages piled up against the door will not drop out when the latter is opened nor will the door scrape and break the freight. The doors opening outward admit of packages being taken out through the small doors without sliding the door back. Access to the interior of the car can be had regardless of the manner it may be loaded.

The inventor, Frank Jager, claims the proper place for a car door is inside of the car, where it is out of harm's way and where it cannot be scraped or torn off by teams or other obstructions, and where snow and ice cannot obstruct its operation. The cost of replacing and repairing outside car doors, the loss of time of cars in bad order on account of defective outside doors, the cost of grain and coal doors, cooperage, pilfering and damage to freight by rain getting into the cars are heavy items of expense which the inventor claims his door overcomes. The hinges on the small door are simply guides, there is no strain on them because the boards are "shiplapped" and lap under each other so that any pressure bearing against the door will not affect the hinges. This door has more functions to perform than the usual outside door and the usual grain and coal door. It necessarily requires more parts, none of which can be discarded and still do any and all kinds of service that the car may be put into. This door is manufactured by the Railway Car Door Co., Peoples Gas Building, Chicago.



Combination Door with Middle Section Open.

REVERSING MOTOR PLANER DRIVE.

Motor driven machine tools are coming to be more and more universally used and one of the latest developments in this line is the direct connected planer drive, manufactured by the Triumph Electric Co., of Cincinnati. This equipment has been in successful service for two years and has passed the experimental stage.

Planer operators conservatively state that direct drive increases the output of a planer at least 50 per cent. This is due to the higher platen speeds and the use of deeper cuts and coarser feeds. The motors recommended for the various size planers have sufficient capacity to remove at a constant speed 50 per cent more metal in the same time than is possible with belt drive. Because of the absolute uniformity of the platen speed under all conditions, the quality of the finished work is considerably improved, a cleaner, smoother cut being obtained. Vibration is materially reduced by locating the driving power on the floor instead of above the work. Better efficiency due to the greatly increased output is also obtained, and in addition there is no loss of power owing to belt slippage during heavy cuts.

The development of the direct drive apparatus is of considerable interest. In the first commercial type the motor was started in the usual automatic manner, stopped at the end of the stroke by dynamic braking, and then reversed by applying reversed power and the cycle repeated. The Triumph-Monitor system dispenses with the dynamic brake, the machine being stopped and reversed by disconnecting the motor and immediately applying reversed power. Reversal with the dynamic brake type was slow, requiring more time than with the belted planer, and on short strokes consuming more time even than in the cutting. It was conclusively proved by taking oscillograph curves that the dynamic braking effect was lost after the speed was reduced, and the motor in fact drifted slowly to a standstill. To reduce this loss of time the braking resistance was reduced, but in order to accomplish reversal as quickly as in the

belted planer, the braking current rose to over 100 per cent overload.

With the dynamic brake type, it will be noted that the motor is subjected to two current peaks, one at the moment of applying the brake, and the other when the reversed current switch is closed. The apparatus is thus under double strain and would be more likely to show wear and tear than if only subjected to one peak load.

In addition, it was found that the stroke varied in length as much as an inch from time to time. This was no improvement over the belt drive, and the matter was given considerable attention. The defect was undoubtedly due to variation in contact resistance and the variation of braking resistance due to heating. The latter effect would allow a stroke continually increasing in length as the cut proceeded. Naturally the customer offered such serious objection to these defects that it was eventually found necessary to dispense entirely with the dynamic brake.

The Triumph-Monitor type accomplishes far better results by applying reversed power to the motor through resistance for both braking and reversing. By properly proportioning the controller resistances, the planer is reversed in less time than is taken by the belted machine, or with a motor drive using a dynamic brake. The peak current load never exceeds 50 per cent overload. A gain of 1¼ seconds per reversal of 2½ seconds per round trip is secured by dispensing with the dynamic brake. Assuming that the average round trip lasts 30 seconds, the gain per ten hour day is 50 minutes. On short stroke work, ten seconds per round trip, or a gain of 150 minutes is obtained. In addition to these advantages it was found that the length of stroke does not vary more than one-eighth of an inch regardless of cutting conditions.

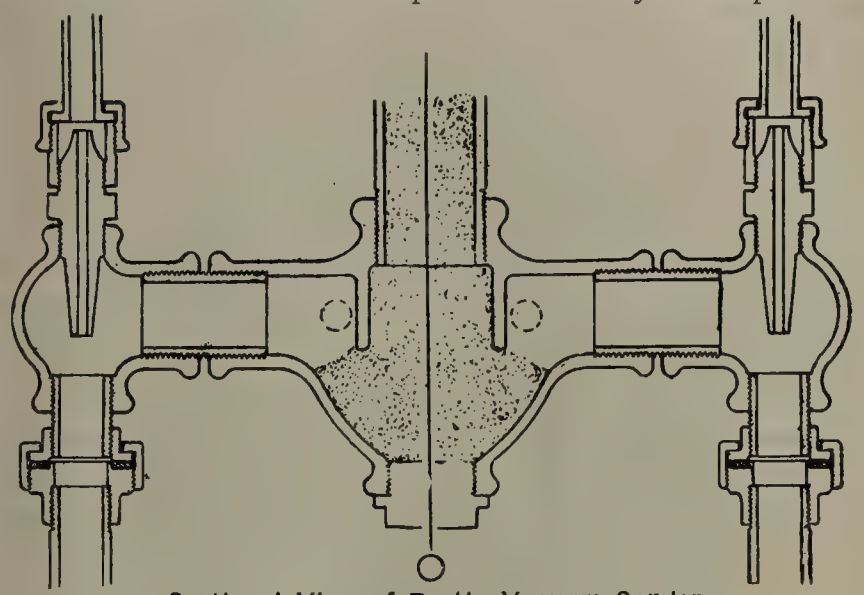
Turning the master switch handle throws power on the motor armature with resistance in series. The resistance is then short circuited and the motor operates as a compound interpole machine with full field strength. Short circuiting the series field converts the motor into a shunt interpole machine still retaining full shunt field strength. The shunt resistance short circuiting switch is then opened and causes the motor to attain its predetermined speed. When the dog throws the tumbler all switches return to their initial positions and power is immediately applied in the reversed direction and the sequence is repeated. The above steps are taken so rapidly that only one second elapses between the throwing of the tumbler and the last switch operation for reversed rotation. At any point in the cycle a reversed movement of the master switch trips all the switches and the planer is stopped promptly. This service is difficult for the motor, yet the motors have been so designed that sparkless commutation for the complete cycle results, in fact the commutator attains that blue-black polish which indicates the entire absence of sparking and perfect commutation.

This company has made exhaustive oscillograph tests on motors adapted to this service, and the above statements are the results secured, condensed in tangible form. It is found that the size of the motor is approximately the same for belt and direct drive, although under heavy cutting load the latter is capable of removing 50 per cent more metal. This is due to the fact that the direct connected motor delivers its entire output to the platen, whereas the platen in the belted type receives only 60 to 70 per cent of the motor output.

Showing Rumsey Car Door Removed.

PRATTE VACUUM SANDER.

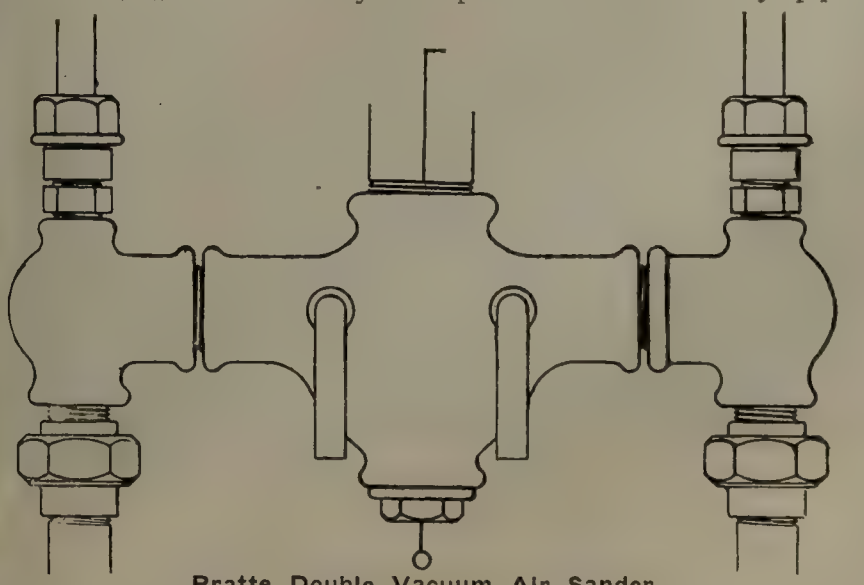
One of the common faults of a great many locomotive sanders is that the pipes become clogged by snow and ice collecting on the bottom. The Pratte sander, which has recently been placed on the market, is said to be very efficient in doing away with these difficulties and at the same time it is simple in construction, which is always an advantage in any mechanism. Its construction may be easily seen by referring to the sketches. The sand from the box drops into the body or trap of the



Sectional View of Pratte Vacuum Sander.

sander by gravity, and is then drawn into the delivery pipes, by air passing through air nozzles, located in the tops of ejectors or vacuum chambers. By vacuum force and by taking the outer atmosphere through the vacuum holes in the body of the sander it creates a force sufficient to deliver sand anywhere required. When the air valves are closed there is practically no sand left in the long runs of horizontal pipe, so that there is no stopping up by accumulating sand. The atmosphere pipes, screwed into the body of sander, are used only to keep snow or rain from coming in contact with the sand.

At the bottom of the sander is a one-inch plug for removing rock and waste that may not pass into the delivery pipes.



Pratte Double Vacuum Air Sander.

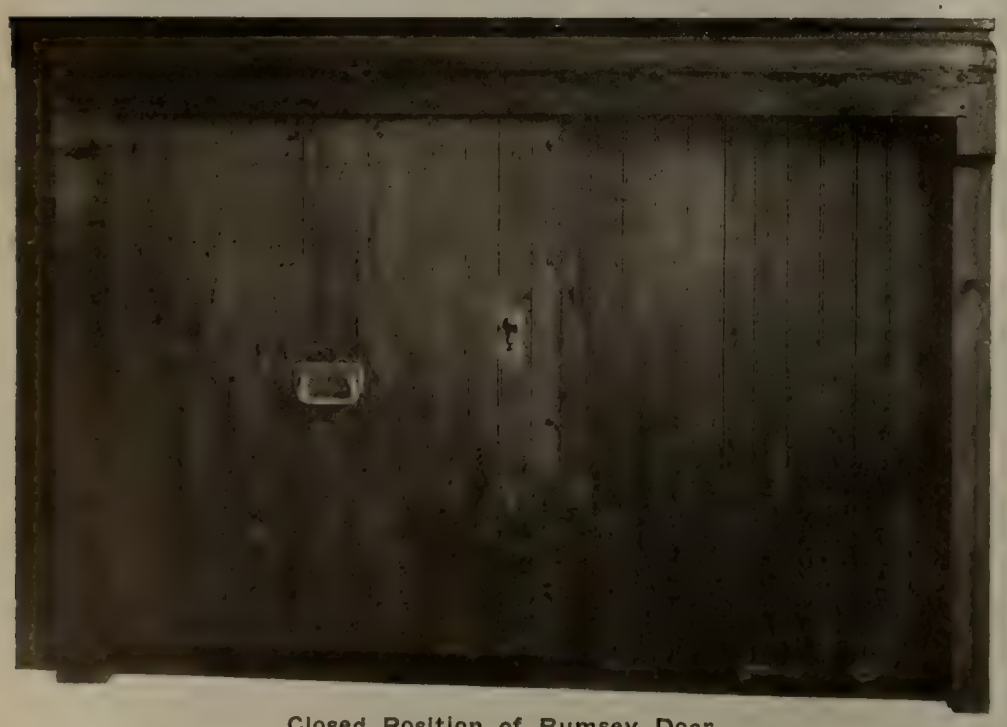
Showing Rumsey Door Open.

Through this plug, a rod passes through the body into the sand box to loosen the sand when it hardens. In storms and bad weather it is only necessary to open the air valves a very little in order to prevent the ends of the pipes from becoming stopped up, as it can be regulated to deliver only a few grains. The makers advise the use of an ordinary ¼-in. globe valve and an air strainer to prevent dirt from reaching the air nozzles. A single sander for use on light engines and electric cars is also made and by using a Y this single sander will do the work of two.

The Pratte sander will use coarse gravel or the finest sand, and moisture in the air pipe does not hinder the even flow of sand. When properly used this sander is said to save about fifty per cent of sand and to effect a saving in tire wear. With dry sand and water-tight connection it is guaranteed to deliver sand whenever required. It is the standard sander on the Colorado & Southern and is manufactured by the Pratte Vacuum Sander Co., 1415 Glenarm St., Denver, Colo.

THE RUMSEY CAR DOOR.

A car door which seems to merit consideration on the part of those interested in car service has been placed on the market by the Rumsey Car Door & Equipment Co., Karpen Bldg., Chicago.



Closed Position of Rumsey Door.

The Rumsey door is shown in the illustrations, herewith. In outward appearance it resembles the car doors universally in use and there is nothing in its design radically different

Inside View of Rumsey Car Door.

from the standard types now in use in so far as the car itself is concerned. One of the principal features of the new door is the fact that it is used in grain carrying service without the auxiliary grain door necessitated by other designs.

This door is attached to the outside of the car and slides in the usual manner. It is maintained in a fixed position laterally, both at the bottom and top, however. In the closed position, the design is such as to force the door tightly against the posts and so seal it. The fit is such as to obviate the necessity of auxiliary doors or small grain can be loaded against the main door without danger of leakage or of moisture. For use in loading grain by spout a small door of similar design is placed at the upper right hand corner of the main door.

For automobile cars it is claimed that this door needs no "bull" post for assisting in the support of the car about the wide opening, the door cannot be opened without unsealing it as none of the fittings are to be reached from the outside when the door is closed. This obviates any danger of pilfering. The sealing device is placed at the right hand side and consists of a very neat and simple stop. Owing to the tight seal of the closed door, it is especially desirable on cars used for the shipment of powder or other explosives.

The door is on exhibition at the exhibit of railway equipment in the Karpen building, Chicago.

STREETER RESILIATOR.

A device for increasing the efficiency of braking apparatus has been placed on the market by the Streeter Supply Co.,

Assembly and Details of Streeter Resiliator.

Old Colony Bldg., Chicago. This device, which is called the Streeter "Resiliator," is illustrated herewith.

The tension members of this device are attached between the live lever and pull rod of the car. It is claimed that its use prevents the skidding of wheels and assists in the easy, quick braking of cars. Distorted brake beams and hangers, it is said, are avoided by the use of the resiliator.

All parts are made of high grade forged steel and in sizes suitable for any class of equipment. The device is in operation in several applications, it is claimed, with marked success.

Industrial Notes

E. W. Strong, of the department of publicity of the American Locomotive Co., New York, has resigned to accept a position with the American Vanadium Co., of Pittsburgh, Pa. Mr. Strong has been connected with the American Locomotive Co. since its organization in 1901. He entered upon his new duties on October 18.

The Bettendorf Axle Co., Bettendorf, Ia., it is stated, will begin the erection of another foundry as soon as the work in progress on the present one is completed.

The Birmingham Car & Manufacturing Co., North Birmingham, Ala., is said to have had its foundry damaged by fire recently.

The Canadian Steel Foundries, Welland, Ont., will make extensive improvements to its plant at Welland. The work will cost about $200,000.

The R. D. Hughes Nut Lock Corporation, Lynchburg, Va., has been recently organized to manufacture nut locks and other specialties.

W. W. Broughton, first vice-president of the Pittsburgh Coal Co., with headquarters at Minneapolis, Minn., has been made president of the Pittsburgh Coal Company of Wisconsin. Mr. Broughton formerly, until March, 1911, was general traffic manager of the Great Northern Railway.

The W. H. Coe Manufacturing Co., Providence, R. I., has been granted an injunction in its suit against the American Roll Gold Leaf Company and Charles E. Smith of Cranston, a former employe of the Coe company, for infringements on the Coe company's patent rights in the use of a machine for packing decorative films and package roll of metallic leaf. The decision was given by Judge Brown in the United States District Court. It is understood that the American Roll Gold Leaf Company will appeal the case.

The Bradford Draft Gear Co., Blue Island, Ill., has been incorporated in Illinois with a capital of $2,500 to manufacture and deal in railway cars and equipment. The incorporators are, Herman C. Priebe, Harry W. Priebe and Charles H. Priebe.

The Snyder Car Line, Chicago, Ill., has been incorporated in Illinois with a capital of $200,000 to deal in tank, refrigerator and other railroad cars. The incorporators are, W. H. Tucker, W. P. MacCracken and N. H. Pritchard.

The Ralston Steel Car Co., Columbus, Ohio, is reported to have awarded the contract for the 400x125-ft. addition to its factory to D. W. McGrath, of Columbus.

The Railroad Supply and Equipment Club connected with the Permanent Exposition in the Karpen building, Chicago, is now open from 8:00 a. m. until 10:00 p. m. Special arrangement for private dinner parties can be made, and on Saturday evening of each week there will be lectures on important mechanical subjects. These lectures will begin at 8:30 p. m. and after 9:30 the dance hall will be open for those who care to dance.

Work on the plant of the Eastern Car Co. at New Glasgow, N. S., is progressing satisfactorily under the supervision of H. H. Lane, of Detroit.

The Locomotive Superheater Company is building a plant at East Chicago, in the neighborhood of the property which has been acquired by the locomotive builders for western plants, for the manufacture of superheaters for application to old locomotives. It is expected that the plant will be placed in operation about the first of the year.

C. A. Carscadin, formerly vice-president of the Kirby Equipment Company, Chicago, and representative of the Globe Seamless Steel Tubes Company of Milwaukee, has been appointed general sales agent of the Spencer Otis Company, with offices in the Railway Exchange, Chicago.

At the regular monthly meeting of the board of directors of the Joseph Dixon Crucible Co., held October 21st, the following changes in the officers and board of directors were made on account of the death of Vice-President William H. Corbin. George E. Long, former treasurer, was elected vice-president, to succeed Mr. Corbin; J. H. Schermerhorn, former assistant secretary and assistant treasurer, was elected to membership in the board of directors, and treasurer of the company, and Albert Norris was elected to the office of assistant secretary and assistant treasurer.

Mark A. Ross, manager of the Pyle National Electric Headlight Co., Chicago, has resigned. Mr. Ross started an active business life as a machinist in 1876 in the shops of the White Speed Recorder Co. He entered railway work as a

Mark A. Ross.

locomotive fireman on the Atlantic & Great Western, now a part of the Erie. This road was at that time operated as wide gauge and was shortly after narrowed to standard gauge. Mr. Ross entered the service of the Wheeling & Lake Erie as a locomotive engineer in 1882. During the succeeding eight years he helped in the construction work on that road. In 1889 he entered the employment of the Garfield Injector Co., which sold out one year later to the Detroit Lubricator Co. After one year's work with the latter concern he went to the National Tube Co. as railroad representative in the injector department. He held this position, with headquarters at the St. Louis branch, for eight years. In 1896 Mr. Ross entered service with Royal C. Vilas, who shortly after organized the Pyle-National Electric Headlight Co. Two years later he was made manager of this concern, which position he has held since with great credit to himself and his company. Mr. Ross has had an unusually thorough training in railway work and has never failed to learn the lessons taught by this experience to the fullest extent. His future work cannot be otherwise than in the nature of a continuation of a most active and useful life. Mr. Ross has been active in the affairs of mechanical associations and has served as president of the Railway Supply Manufacturers' Assn.

Recent Railway Mechanical Patents

CONNECTING-ROD FOR ENGINES.

1,042,543—James R. Foulder, Schenectady, N. Y.

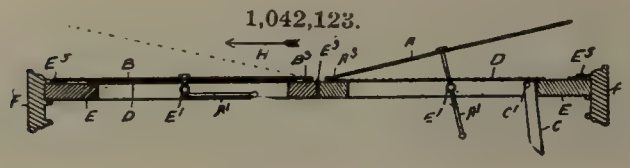
This is the combination of an engine connecting rod having a longitudinal crank pin brass opening formed in its head, an adjoining wedge space of greater depth, and a pair of symmetrical crank pin half brasses fitting in said opening and having symmetrical end flanges extending entirely around their bearing surfaces. Means are located in the wedge space for adjusting said half brasses.

PIPE-WRENCH.

1,041,978—Edward G. Diefendorf, Erie, Pa., assignor to Erie Stamping & Mfg. Co., Erie, Pa.

A method of forming the body of a pipe-wrench consisting of cutting a blank of sheet-metal having pivot-holes adjacent to one end thereof and with curved jaw surfaces around the end adjacent to said pivot-holes. The blank is then rolled up so that the side margins meet along the front of the wrench body with said pivot-holes in alignment and flattening the jaw-end thereof.

1,042,123.



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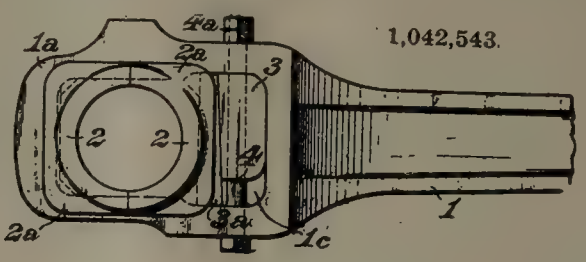

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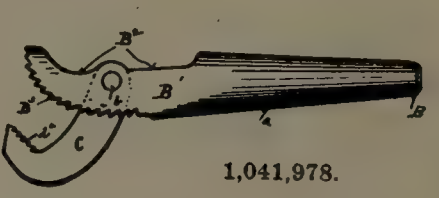


CAR-WINDOW SCREEN.

1,042,123—Edward William Kolb, Westmount, Quebec, Canada.

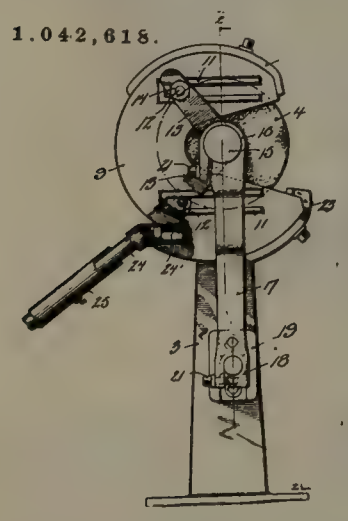
A car window screen having a frame in two sections hinged together in the middle of the frame, in combination with a pair of shutters hinged at their proximate ends to the frame sections. These are hinged near the midde point. A deflector plate is hinged to said frame near the rear end thereof, the same being arranged to receive the impact of the air directed inwardly by the forward shutter and to deflect the same outwardly through the rearward screen.

SLIDING-DOOR LOCK.

1,042,326—Herman V. Cookingham, Rensselaer, and George O. Price, Albany, N. Y.

This is the combination of a sliding door, a track for the door, and hangers fastened to the lower end of the door and provided with depending hooks. These are adapted to engage the under side of the track, the wheels being journaled on the said hangers and mounted to travel on top of the track. Wedges pass between the wheels and the track to raise the door and to firmly engage the hanger hooks with the track. Each wedge has an inclined slot, a bolt on the corresponding hanger and extending through the slot of the corresponding edge, a lever having a handle and fulcrumed on the door. Links connect the ends of the lever with the wedges.

1.042,618.



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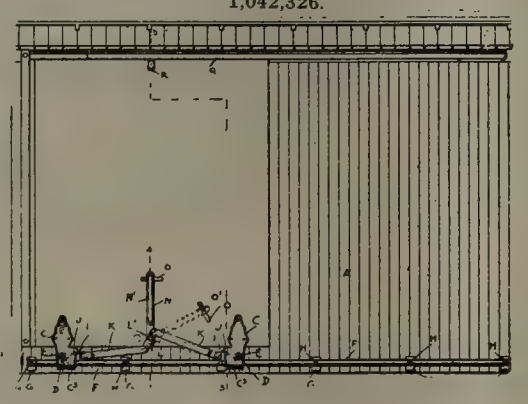

GRINDING-WHEEL GUARD.

1,042,618—William Stone, Milwaukee, Wis.

The parts of this mechanism consist of a support, a post having a split foot engaging the support, a spider having the hub thereof engaging a split head of the post, a grinding wheel guard-hood attached to the spider, and means for clamping said post on said support and spider-hub.

RAILWAY CONSTRUCTION.

The Chicago & North Western will extend its six track system from River Forest, Ill., on the Galena division to the new Proviso yards, near Melrose Park. This will be done early during the coming year, and it is expected that the construction and elevation of these tracks will cost $2,500,000. The present bridge over the Desplaines river near River Forest will be replaced by a six-track structure and the capacity of the Proviso yards will be increased, giving the North Western the largest freight yards in the country, outside of the Pittsburgh yards of the Pennsylvania.

Flemington, Hinesville & Western contemplates building from McIntosh, Ga., west, via Flemington and Hinesville to Glenville, about 30 miles. Track has been laid and is now in operation on a section of five miles to Hinesville. The company expects to complete the work on the entire line in the near future. A. D. Way is president, Hinesville, Ga.

The Cincinnati, Bluffton & Chicago is said to have completed plans and surveys for an extension from Portland Ind., to Hamilton, Ohio.

The Maine Central, it is reported, has made surveys for the extension of its Somerset branch to the head of Lake Chesuncook, a distance of 50 miles. The new line will start near Kineo, on Moosehead lake, running along the lake and crossing the west branch of the Penobscot river, at Russell stream and then to the head of Lake Chesuncook.

The Savannah, Union Railway & Terminal Co. has been incorporated in Georgia, to build a railway connecting the mill site of the Great Eastern Lumber Co., seven miles above Savannah, with all the railways entering Savannah. About five miles of track has been laid. The company plans to develop a terminal business at the point where it reaches the Savannah river, and where it will have deep water facilities.

The Atchison, Topeka & Santa Fe, it is reported will construct a branch from the main line to Oceanside, Cal., five miles up San Luis Rey valley to San Luis Rey mission.

The People's Railroad Co., Fairhope, Ala., plans the construction of a line from Fairhope via Silver Hill to Robertsdale, a distance of about 13 miles. The officers are as follows: E. B. Gaston, Fairhope, president; Rev. C. G. Johnson, Silver Hill, vice-president; E. G. Dougherty, Fairhope, secretary and William McIntosh, Robertsdale, treasurer. Survey is made and about one-half of the right of way is reported to be secured.

STATEMENT AS TO THE OWNERSHIP AND MANAGEMENT OF THE RAILWAY MASTER MECHANIC, IN ACCORDANCE WITH ACT OF CONGRESS, AUGUST 24TH, 1912.

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President—William E. Magraw, 431 So. Dearborn St., Chicago.
Editor—L. F. Wilson, 431 So. Dearborn St., Chicago.
Managing Editor—Owen W. Middleton, 431 So. Dearborn St., Chicago.
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(Signed)
WILLIAM E. MAGRAW, PRESIDENT.

Sworn to and subscribed before me this 1st day of October, 1912.
(Signed) Robert R. Grieg,
Notary Public.

(My commission expires Oct. 26th, 1915.)

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Published at the World's Greatest Railway Center
Established 1878

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MECHANICAL CONVENTIONS.

The annual convention of the American Railway Master Mechanics' Association will be held at Atlantic City, N. J., on June 11, 12 and 13, 1913, and the convention of the Master Car Builders' Association will follow on June 16, 17 and 18. Thus the Master Mechanics will be in session on Wednesday, Thursday and Friday of the first week and the Car Builders on Monday, Tuesday and Wednesday of the second week. The dates were fixed at a joint meeting of the executive committee of the two associations and the Railway Supply Manufacturers' Association held at New York on November 14. An effort was made to take the conventions to Washington, D. C., but Atlantic City has become so firmly associated with the meetings that the move to take them elsewhere was defeated. It is doubtful if any other place can be found which can provide the facilities and space necessary for a convention of this size and at the same time so localize it that there may be a concentration of interest.

WHEEL SLIDING.

Heavy passenger equipment seems to be becoming more and more subject to the costly and embarrassing difficulties due to slid flat wheels. A paper on the subject read before the Central Railway Club, Nov. 8, by John P. Kelly, points out the major causes and suggests changes in design to overcome the difficulty.

Mr. Kelly shows that the computations of brake apparatus designers allow too little a margin of safety in their attempt to secure the maximum retardation. He shows that the resultants of the braking force combined with other conditions tend to neutralize the effect of the equalizing springs and thus allow of one wheel of a truck at a time being relieved of its pressure on the rail for some distance. This, of course, allows the wheel to be retarded to such an extent that upon a return of contact pressure between wheel and rail, the wheel is moving so much slower than the horizontal movement of the car that sliding starts. The difference between the coefficients of static and sliding friction then operates to keep the wheel locked. The conditions which produce this result include a slight irregularity of track surface. Those who must cope with the exacting conditions of fast passenger train service and who have experienced the necessity of transferring whole train loads of limited train passengers, will appreciate the concluding remarks of Mr. Kelly which are as follows:

"It seems to me, therefore, that in the future, brake designing will have to take into consideration such type of truck and brake rigging as will produce the desired retardation, that will least interfere with the equalizing springs and that will permit them to perform their proper functions with the same efficiency while brakes are applied as while they are released. The braking power must then be fixed to suit this condition. Many things which singly are not of sufficient magnitude to cause wheel sliding may in their cumulative form produce it, such for instance shock during time of application and adjustment of slack in train, unevenly retarded vehicles in the same train, moisture and drippings on the track, methods of handling, etc., but it seems clear that the term "braking power" no longer means much to us;

and in future the first consideration will be that of brake gear and truck design that will keep the wheel constantly in contact with the rail, while the brakes are applied then for a brake shoe that has the required frictional qualities to produce the desired amount of retardation without the use of excessive shoe pressure, and a scheme of leverage that will produce the necessary shoe pressure with the lightest pull in the cylinder lever pull rod."

A SUGGESTION IN TENDER DESIGN.

As noted in a previous editorial, the question of tender derailments has obtained more or less prominence recently because of the fact that a number of wrecks have been traced to this cause. This question, like that of leaky flues, has always been with us, but the particular attention which has been called to it of late, has renewed interest in improving the present design of tenders. On another page J. J. Clark of the Tennessee Central discusses the method which he claims has eliminated tender derailments on his road, its important points being a change in location of the side bearings and changing the center bearings to a spherical shape. It can be seen that the location of the side bearing does have considerable influence on the stability of the tender, for the pressure on the inner side bearings when the tender is rounding a curve is transmitted through the bolster to the journal and produces a turning movement which tends to raise the outer wheels. The nearer the center we move these bearings, the less that turning moment will be, it being borne in mind that the effect of the pressure on the side bearing is always transmitted ultimately to the journal. But practice has shown that there are certain limits for the side bearings and they are a necessity in tenders as at present designed.

The problem of weight and its distribution is an important one in tender design, the weight of the tender per axle being greater than that of any other unit of the train. In the distribution of the weight, its influence on the truck could be more easily controlled if it acted through a single point. Theoretically this is what the sperical bearing does and Mr.

STRIKES.

An arbitration board after thoroughly studying the wage dispute between the enginemen of the Eastern railways and their employers, has recently handed down a decision which comes far from meeting the demands of the former. Both parties in the controversy are however bound by agreement for one year to accept the schedules as arranged by the board.

The results of this arbitration are of minor importance compared with importance of the principle involved. The following quotation from the findings of this board of arbitration is calculated to make men of large responsibilities do some hard thinking:

"From the viewpoint of the public, it is an intolerable situation when any group of men, whether large or small, has the power to decide that a great section of the country as populous as all France shall undergo great loss of life, unspeakable suffering and loss of property beyond the power of description, through the stoppage of a necessary public service."

Without doubt the group of men in question have secured greater recognition through the strength of their organization than the justice of their demands warrants. While it is true that extremely unjustifiable demands, if persisted in, would ultimately destroy any labor organization, no matter how strong, the enginemen have always kept just within this limit, while still procuring for themselves advantages out of proportion with those enjoyed by men of equal responsibility and ability in other walks of life.

This situation was touched upon editorially in the *Railway Master Mechanic,* issue for October, 1911. Under the heading, "An Interstate Labor Commission," this journal urged the supervision of labor by commission. It would seem logical that this supervision of labor has its best application in that concerned in interstate commerce. The same commission which qualifies itself to regulate the carriers should be in excellent position to also regulate the labor incident to their existence. For an arbitration board to award wage increases to large bodies of employes, when the railways are unable to finance such increases without securing from the Interstate Commerce Commission the permission to raise rates, seems like a great waste of effort, in as much as the Commission must go into the whole subject over again.

The Commission which regulates the income of the railways should apply the knowledge gained in its constant study of the subject to the regulation of the major part of their expenditure,—wages.

SUPERHEATING.

A paper read before the New York Railroad Club, November 15, Gilbert E. Ryder, was interesting in its precise and careful statements as to the present status of locomotive steam superheating. Aside from the description of the superheater principle and its application and a discussion of the results to be expected, the most interesting features of the paper deal with the application of the superheater to switch engines, and the increase in hauling capacity of the road engine equipped with the superheater.

The discussion of the subject was somewhat disappointing as it diverged widely from the subject in hand. In fact, it consisted, to a considerable extent, of a friendly scrap between two well-known members on the subject of lubrication. The lack of more pointed discussion was, in this case, a compliment to the author of the paper, as his statements and explanations were so candid and so evidently not the result of anything but careful experimentation that there was little room for the difference of opinion which usually starts discussion.

One of the author's statements which should have called for comment is stated as follows:

"Assuming that the saturated steam locomotives are economically rated on the division of a railway conducting principally a freight traffic, the addition of the superheater will increase the ton miles per hour over the division from twenty to thirty per cent, thus providing the same railway facilities on about twenty-five per cent less investment for power; or twenty-five per cent more facilities for the same investment."

It should be pointed out in connection with the above that it is not meant that a superheater locomotive can start a longer train than can one of the same dimensions using saturated steam. The increase in ton miles is obtainable through increased boiler capacity and the superheater is a boiler and not an engine adjunct. The saturated steam locomotive can start a heavier drag of cars than it can get over its division in good time. The superheater locomotive, while not being able to start a larger tonnage, can, on account of its increased boiler capacity, economically haul more nearly the tonnage that could be started by either locomotive.

The high maintenance bugbear seems to have been pretty well eliminated from the superheater question. Whereas several years ago discussions of the superheater almost invariably dwelt heavily on the cost of maintenance as an objection to its use, now the superheater is taken as a matter of course and the maintenance difficulties are not considered of sufficient importance to require special consideration.

DISSOLUTION of the Union and Southern Facific merger was ordered by the United States Supreme Court in a decision handed down on December second, the court being of the opinion that the holding of Southern Pacific stock by the Union Pacific was in violation of the Sherman anti-trust law. According to the decision a road may acquire connecting lines or feeders but cannot obtain control of a competing line. Thus the Union Pacific may still retain control of the old Central Pacific connecting Ogden with the coast. This decision ends the suit started in 1908 by Attorney General Bonaparte and is the beginning of the separation of the great railroad organization built up by the late Mr. Harriman. The roads are given three months in which to affect a separation. It is stated that the decision will affect a number of large systems, including the New York Central, the New York, New Haven & Hartford, the Missouri Pacific, the Great Northern and Northern Pacific and others.

THE TELPHERAGE SYSTEM was the subject of a paper read before the Western Railway Club at its meeting on November 19, the paper being read by H. McL. Harding, consulting engineer. It was illustrated with lantern slides showing many inefficient methods of handling freight and also good examples of efficient methods which have recently been installed. He emphasized the important points of any system for handling materials at terminals and elsewhere, among them being continuityof movement, the ability to pile and rapidity of movement. Undoubtedly the crane and telpherage system is not as highly developed in this country as it is in foreign countries, particularly at large harbors and freight terminals. Much of our freight congestion could be relieved by the installation of more efficient system of handling package freight, for as the writer pointed out, it is the number of times that freight has to be handled that causes the delay and increases the cost.

LOCOMOTIVE FUEL CONSUMPTION AND THE SPEED DIAGRAM.

Editor *Railway Master Mechanic*: Since the adoption of the "constant formula" for train resistance by the American Railway Engineering Association, several articles on the economics of railway operation have been published, using the formula which shows no change for corresponding speed changes. Among these, the article by A. K. Shurtleff on page 453 of the October issue of Railway Master Mechanic is typical, and, like all others, leads to conclusions which are unusual. There has appeared since the adoption of the "constant formula" a most enlightening publication on train resistance which proves in a thoroughly scientific manner that train resistance varies with the speed. Professor C. C. Schmidt of the University of Illinois, in Bulletin No. 43 of the Illinois Engineering Experiment Station, gives a complete study of the subject with results obtained from many tests made with the dynamometer car, which deserves to become the basis of any modern economic study. The committee which influenced the American Railway Engineering Association into the adoption of the "constant formula" were not in possession of this latter data, but deserve credit for the extensive investigation they made, and especially for the word of caution in which they recommended that the test records from dynamometer car tests should be used whenever they were available. This virtually adopts the results as published in the bulletin above mentioned, since it is the only one which has shown the scientific basis for the comparison of train records. Mr. Shurtleff assumes that "5.4 pounds per ton is the train resistance for a car of 30.7 tons average from four to thirty-five miles per hour." In the above bulletin, on page 35, Professor Schmidt shows that a thirty-ton car will give a train resistance from 5.4 pounds per ton to 8.8 pounds per ton between those speeds. In other words, it has been thoroughly demonstrated beyond any possibility of a doubt that the resistance at 35 M. P. H. will be over 50 per cent greater than that adopted by Mr. Shurtleff in his article, and as this factor is a "multiplier" it will alter the result in a large way. The writer indicated the importance of this factor in *Railway Master Mechanic* of June, 1911, page 220, and showed that by a mathematical correlation of the data the speed influenced the values 45 per cent and the weight of the cars influenced them 55 per cent. The contention of those favoring the "constant formula" has been that the weight was the only factor. It was the "pendulum swinging" from the old formulas in which the speed was considered the only factor. As a matter of fact, the scientific investigation shows that both are factors and hence any problems in railway economics should, recognizing this later data, be based upon a train resistance varying with the speed. J. G. VAN ZANDT.

THERE ARE two kinds of discontent in this world—the discontent that works and the discontent that wrings its hands. The first gets what it wants, and the second loses what it has. There's no cure for the first but success; and there's no cure at all for the second.—Gorgon Graham.

The receivers of the Missouri & North Arkansas, and Judge Trieber, have signed a contract to locate the machine shops and general offices of the M. & N. A. at Harrison, Ark. The shops are to cost not less than $125,000 and the monthly pay-roll is to amount to $30,000 per month.

ANTHRACITE COAL AS LOCOMOTIVE FUEL.*

Considered as a fuel, the hard and non-porous nature of anthracite makes it a slow-burning coal. On account of this characteristic there is a disadvantage in its use for locomotives (where a high rate of combustion is essential), as a large grate area must be provided. Where it is desired to use hard coal exclusively in locomotives, economical combustion necessitates special boiler and fire-box construction, having ample grate areas. Another hindrance to its locomotive use, is the high price, except in the immediate vicinity of the anthracite mines. These two factors have militated against it for locomotives of roads, other than the "Hard-Coalers."

The use of soft-coal locomotives, mostly freight and yard engines, is accounted for by the fact that the Erie runs through soft-coal territory, that the Lake Erie extensions of the Lackawanna and of the Lehigh Valley are much nearer to the bituminous than to the anthracite fields, and that the L. & H. and the L. & N. E. do not directly touch the anthracite mines, and therefore have to pay freight on hard as well as on soft coal.

The first anthracite used on locomotives was in the form of large lumps; progressively smaller sizes (the smaller or "steam" sizes being generally cheaper) have been introduced satisfactorily.

The sizes and mixtures now currently burned on the locomotives of the hard-coal roads are:

Service.	Size or Kind of Fuel.		
Through passenger..	Lump only or	Lump plus trace to half soft	or Egg, Stove, or Chestnut plus
Local passenger.....	Pea only or	Buckwheat plus about half soft.	
Fast freight.....	Pea only or	Buckwheat plus about half soft.	or Buckwheat only.
Slow freight.....	Pea only or	Buckwheat plus about half soft.	"
Yard	Pea only or	Buckwheat plus about half soft.	"

When it can be obtained, rice and barley are used by some roads in place of buckwheat.

Of course as smaller sizes are used grates with smaller openings have to be provided, the principal difficulties with the smallest sizes being the obtaining of a proper draft, first to draw through the bed of fine coal, and second not to carry the small particles through the flues to the front-end unburned.

The disadvantages attendant upon the use of hard-coal for locomotives (special fire-box and usually higher price) have been mentioned. Its advantages for this use may now be summarized.

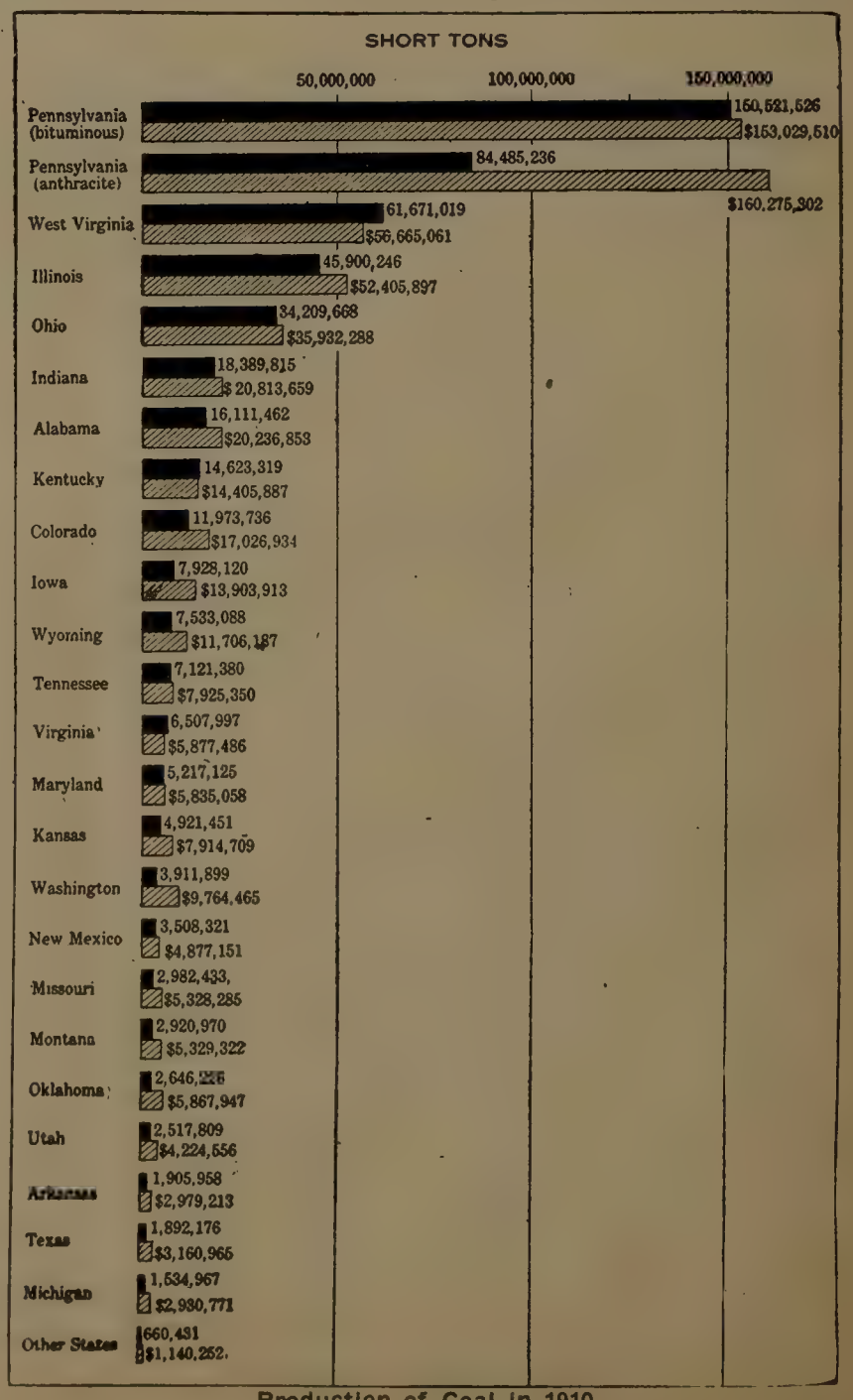
1. It is hard, compressed, therefore:
   - Not friable.
   - Little chemically affected by air.
   - Clean to handle and non-slacking.
   - Will stand handling, shipment, storage, and weathering with no appreciable loss.
2. Absence of hot sparks, reduced fire risk, sparks becoming dead soon because of absence of volatile combustible.
3. Least smoke of any solid (or even liquid) fuel.
4. Absolutely no annoyance to passengers, because of absence of cinders and smoke, permitting open windows, ventilators, etc.
5. Less production of gas in tunnels.
6. No annoyance in cities, easier to burn than coke.
7. Fire not glaringly hot for fireman.
8. Less frequent firing necessary.
9. Longer life of fire-box and of grates because of almost complete absence of sulphur in coal and clinker.
10. The cinder loss increases at a less rate with increase of draft than with bituminous coal.
11. Because of less cinders, less likely to choke superheaters.
12. Where a cinder ballast is desired, its ash is harder and contains less acid.

Because of the limited supply (the entire anthracite production for all markets is less than the total consumption of fuel by all the locomotives of the United States), there can be no question of the general introduction of hard coal by the railroads of this nation, even for their passenger locomotives. The roads of anthracite must long continue to have the advantage over those of other sections of the country in this respect.

For use, however, in and near large terminals and cities, very serious consideration is merited in favor of this fuel. The only alternatives to its adoption are: The continuance of soft coal (with the usual attendant smoke and popular clamor). The substitution of coke (harder to burn than anthracite, and also high priced and limited in quantity and locality of production). The possible future use of briquets as in Europe. The substitution of oil, or electrification.

Briquets have yet to prove themselves against the relatively cheap coals of this country; but their ultimate introduction on a large scale in locomotive service here seems certain. The most successful and extensive use so far in America of a briquet has been of one made from anthracite culm.

Oil, while being in most respects an ideal fuel (except for its destructive effect on fire-box sheets), and while now used extensively and economically on locomotives in the



Production of Coal in 1910.

*From a paper by T. S. Lloyd before the International Fuel Association.

southwest, is practically out of the question for urban use elsewhere, because of the limited supply, and of the vast extension of the demand for it in refined form for the hundred thousands of automobiles today and of air craft tomorrow, making the price for the crude, basic, petroleum prohibitive for extensive railroad use.

Freedom from smoke and cinders makes anthracite an ideal fuel generally, and especially in the neighborhood of large cities. The small amount of inoffensive gas from a few hard-coal burning locomotives is unobjectionable. The only questions are: as to its adaptability to locomotives in present service at the different cities, and as to its cost.

About half the locomotives causing smoke near a large city are in switching service. It is well known that the draft on a yard engine is usually not heavy, and therefore we may assure you that the yard locomotives in present use could almost without exception be adapted for anthracite by changing the grates only. The lower priced, small sizes can be successfully used.

Of the freight and passenger engines, almost all now built have quite wide fire-boxes, the narrow fire-boxes rapidly being retired to small branch line service or to limbo. The wide boxes have a grate area sufficient to burn a mixture of anthracite and bituminous wtih a full head of steam while in the city and suburbs, and I may say that such a mixture properly fired is practically smokeless.

As a practical method of firing on lines running in large cities, I would suggest:

On going out:

1. Cover over a brightly burning soft-coal fire with Anthracite, preferably Pea.

2. Place enough hard-coal in the forward part of the tender for feeding through the city and suburbs.

On coming into the city:

1. Load the necessary supply of hard-coal in the back of the tender at the last preceding coaling station, or at a special small Anthracite coaling station 10 or 20 miles from the terminal, perhaps at the first suburban stop, or

2. If the distance does not exceed 10 or 15 miles, and the grades do not require too much work, for the fireman to be trained to prepare in advance a heavy soft-coal fire, and gradually let it burn down, so as to enter the city with only the lightest charging of coal by careful placing of small scoopfuls.

If the locomotives engaged in suburban, transfer, and yard work alone were arranged to consume Anthracite for fuel the abatement of the smoke nuisance would be so pronounced, it would mean practically abolition, as far as concerns that emanating from locomotives. If the gases and more particularly smoke from locomotives using Bituminous fuel are as destructive to property and goods in business houses as claimed, it should accentuate the importance of at least a trial of hard-coal.

Having had long experience on both hard and soft coal roads, I recommend for your earnest consideration this possibility of a use of Anthracite for locomotives in spite of its higher cost, as an offset to the propaganda for electrification, particularly in the present unstandardized condition of electric construction and operation.

Urban electrification, from the only sufficiently large installation, yet attempted (at New York City) is now known to be prohibitive—to require hundreds rather than tens of millions of dollars, for any of a dozen large terminals in this country—and to yield a minus quantity in a net operating economy over all charges, without offsetting increases in revenue.

We have admitted that the employment of anthracite on trains, etc., will not only entail certain inconveniences, but also materially augment the cost of fuel for locomotives, and this will naturally not be a welcome proposition to the stockholders and managements of railroads already facing advanced costs of raw materials and manufactured products purchased, wage increases, etc., besides further embarrassment resulting from the exactions of federal, state and municipal commissions and inspections, without any allowance for compensating increase in rates. The use of hard-coal on locomotives in cities is suggested as worthy of serious consideration to abolish the smoke nuisance, therefore, chiefly as an offset to the unreasonable demand for electrification, which, as stated, would involve prohibitive additions to capital outlay, and annual interest charges thereon—unless of course the municipalities would finance the change themselves, since it is exclusively for their benefit, leaving to the railroads only the costs of repair and operation.

GRAPHITE AS A LUBRICANT FOR LOCOMOTIVES.

By L. H. Snyder.

On a superheating engine of the Pacific type, which hauls the Lackawanna Limited between Scranton and New York, the company has tried out a device for automatically supplying graphite to the cylinders. Records made during the test indicated a consumption of 12.37 pounds of coal per mile without the graphite and 11.43 pounds with it, or a saving of 7.7 per cent in fuel. Based on the company's coal bills for the past year, this seems to point the way to an annual saving of $260,000.

The above is of interest in connection with this subject from two very important view points; namely, fuel economy and maintenance. We might also say a third reason, economical lubrication.

Primarily the object of a lubricant is to relieve friction by preventing the actual contact of the metal surfaces and substituting the lower friction of the lubricant itself. Any bearing surface is shown by the microscope to be irregular, and in fact, it has the appearance of a relief map. It is the high spots scraping together and gradually wearing away that causes worn parts and hot bearings. Flake graphite has a strong affinity for metal surfaces; the thin flakes of graphite attach themselves to the high spots and soon there is formed over the whole bearing surface a thin, tough, veneer-like coating of marvelous smoothness and durability.

In this connection Prof. Goss says in one of his tests: "The tests show that with no other lubrication than flake graphite, the journal and brass may be run together for hours at a time heating up to a high temperature, and this may be done repeatedly, and yet the rubbing surfaces of the bearings remain unscored. As a protection against abrasion of rubbing surfaces, I know of nothing that can equal the record of flake graphite as herein disclosed."

Flake graphite has many qualities which make it unsurpassed as a lubricant. The most important is that it is unaffected by any temperature encountered in railway service, which makes it particularly adapted for use in connection with superheated steam. Tests have shown that it takes considerable time for a drop of oil to get from the lubricator to the steam chest and very serious cutting might take place before an additional supply of oil could be had at the parts needed, but when Flake Graphite is used regularly with oil through a special graphite lubricator this will never happen. Best results are obtained when graphite is used regularly with oil or grease. The difficulty in using graphite alone is in getting it evenly distributed because of its extreme lightness, and oils best furnish the proper vehicle.

It is interesting to note some of the special uses of flake graphite. When flanges are lubricated with flake graphite, there is a marked decrease in flange and rail wear. Often the life of tires is increased several times. When centerplates and side bearings are thus lubricated, the train is

flexible and easily manipulated; in fact, the scientific application of flake graphite permits of far less viscous lubricants being used and this would be particularly noted in power consumed in starting a train.

Many locomotive engineers tell how much easier a locomotive handles when flake graphite is used, and how much more power they can get out of the same locomotive; this difference being particularly noticeable upon grades.

There has been for some time a great deal of discussion as to the relative superiority of dry graphite and grease or oil for triple valve lubrication. At the present time, there seems to be a strong sentiment in favor of dry graphite, for it is claimed that if a suitable grade of graphite is selected and properly applied, some of the objectionable features attending the use of grease or oil do not appear. Extended tests by certain air brake authorities have proved so successful that dry graphite alone is recommended for use on the triples. At the 18th Annual Convention of the Air Brake Association the subject was given considerable attention, and the committee on Recommended Practice advises the following treatment be carefully adhered to:

"The triple valve slide valve and its seat in the bushing should be lubricated with a high grade, very fine dry graphite, which should be applied as follows: After all oil and grease have been thoroughly removed from the slide valve and its seat in the bush, the dry graphite should be rubbed into the face of the slide valve, its seat in the bushing and the upper surface of the bush where the slide valve spring bears, with a view of filling the pores of the metal with graphite. After the graphite has been thoroughly rubbed into the parts mentioned, a light coating of loose graphite should be placed on the seat and the slide valve placed in the bushing.

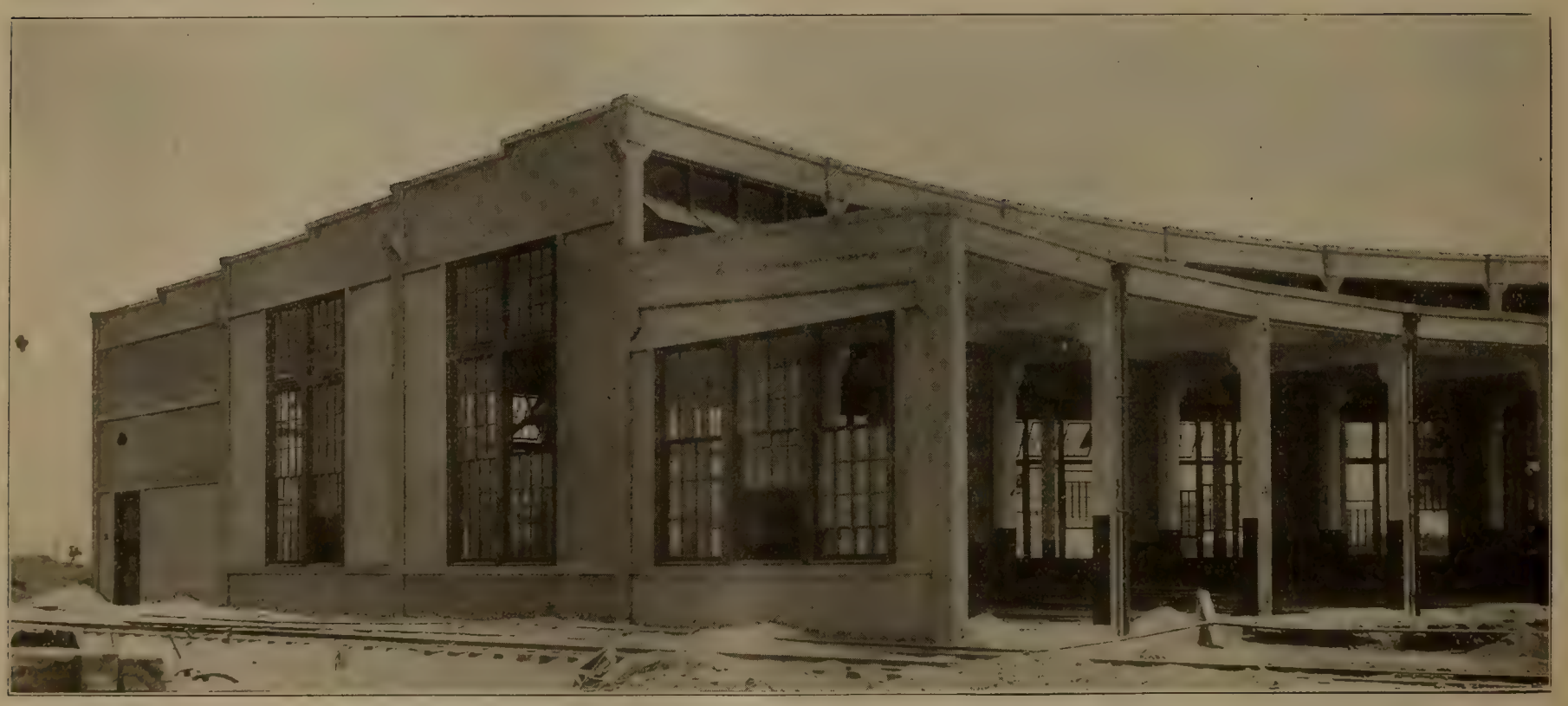
The New York *Sun* in a recent issue has the following to say concerning the subject of graphite as a lubricant.

Graphite is coming into its own as a lubricant. Unlike Duluth, the fair city at the head of the Great Lakes, whose name Proctor Knott describes as "slipping off the tongue," the name of graphite is harsh, suggesting just the opposite to its smooth qualities. Like Duluth, however, it had its early struggles for recognition and is only now fairly on its way to the place among the smooth things in creation to which it is entitled.

The rise to position which this humble non-metallic mineral is now enjoying is due largely to the requirements of the scientific advancement in steam propulsion. From the little old locomotive, which in times past crawled along the steel rails, to the modern superheater capable of great speed and with great hauling power is a far cry. Likewise there are not only steps but leaps from the long snouted oil can, which the old time locomotive engineer depended upon for oiling up the creaking joints of the iron horse, to the modern automatic feed of lubricants to all parts of the big present day locomotive.

It is, however, the unusual high temperature of the steam used in the new big engines, calling for a lubricant which does not easily volatilize, which gives to graphite its growing importance. There is more power in the superheated steam and quicker action in the modern slide valve cylinder motion. To lubricate a surface such as the inside of a cylinder of one of these new locomotives, constantly in contact with steam having a temperature of more than 600 degrees, is difficult and costly for petroleum products, except with the assistance of a substance like graphite, which will not "burn off."

While different in appearance and formation, it is a matter of discussion among scientists whether coal, petroleum and graphite are not the same vegetable origin. Petroleum is described as a hydro-carbon. Coal is basically a carbon. Merill in *The Non-Metallic Minerals* says, "Chemically graphite is nearly pure carbon." Merrill also says of graphite, "Its most characteristic features are its softness, greasy feeling and property of soiling everything with which it comes in contact.



Showing End and Portion of "Unit-bilt" Roundhouse at Riverbank, Cal.

SANTA FE ROUNDHOUSE AT RIVERBANK, CAL.

The Atchison, Topeka & Santa Fe has recently constructed at Riverbank, Cal., a 90-ft. 15-stall roundhouse which presents several interesting features. It is built entirely of reinforced concrete, conforming in this respect to the present tendency among railroads to make all new structures of a permanent character, thoroughly fireproof.

Although this roundhouse is of the usual type and built of the usual materials, the actual methods of construction are unique. Instead of pouring the concrete in place upon an expensive system of forms, it is cast on the ground in a number of moulds. The structural parts are all cast in this way, and are known as units, the building being constructed along "Unit-Bilt" or "moulded in advance" methods as patented by the Unit Construction Co.

In this work the concrete was poured in wooden moulds arranged in a casting yard adjoining the building site. The reinforcing steel was locked in place in these moulds, which

Interior of Santa Fe Roundhouse at Riverbank.

were carefully inspected before concrete was placed. After concrete had set, the members or "Units" were lifted from the moulds by a crane and set in the building much as if they had been structural steel.

The foundation of the building was arranged with slots to hold the columns which were grouted in place after. setting. Wall columns were slotted to receive wall slabs and after girders were in place the joint was boxed and a rich concrete grout poured around the steel bars projecting from ends of girders, making a very strong joint. Roof slabs were then placed on girders and all remaining joints grouted. Thus the completed building is practically a monolith; with the added advantage that the method of construction insures accuracy of design, quality of workmanship and strength seldom obtained by ordinary reinforced concrete methods.

The windows in the rear wall are about 15 ft. wide, and extend from a point about 3 ft. above the floor to the bottom of the eave strut. There are heavy pilasters at the sides of the windows while the panel below the window is made of very light construction so that an engine pushing through the wall would not in any way damage the structural part of the building, and would cause only slight inconvenience and expense in replacing the window and panel beneath. At the end of the house, provision is made for further extension by making the end wall slabs so that they may be easily removed without damage and by providing special roof connections.

Aside from the construction features, the roundhouse is of the ordinary standard type and presents no unusual features. However, the clean, light and airy appearance of the building is noticeable in the illustrations. This method of putting up buildings while new as applied to roundhouses, has been in general use for several years in various parts of the country in connection with the construction of factories, warehouses, grain elevators.

An incident during this construction gave an excellent example of the advantages offered by "Unit-Bilt" methods. By mistake, the contractor received a quantity of sand containing considerable mica which weakened the concrete. The first roof slab containing this sand, broke as it was being lifted from the mould and all units containing that kind of sand were at once destroyed. Had the building been constructed by ordinary methods the defect would not have been discovered until removal of centering when the building would have collapsed.

This roundhouse was erected by the Van Sant-Houghton Co. of San Francisco, Pacific Coast representatives of the Unit Construction Co. of St. Louis, who control patents covering this method of construction.

TREATMENT AND FINISH OF PASSENGER CAR CONCRETE FLOORS.*

Treatment and finish of passenger car concrete floors is representative of present-day progress. Incidentally it affords the opportunity for interesting and valuable study into comparatively new fields, and has for its basis not alone economic principles of conservation, but also the development of ideas concerning the decoration of surfaces which would in their natural state appear lifeless or unsightly.

Two distinct reasons present themselves, which bespeak the advisability of treating concrete construction, namely, to act as a preservative against the forces with exert deteriorating influences, and to improve the appearance. Although, generally, the greatest stress is laid upon the decorative properties, the fact remains that proper paint coatings impart protection which annually amounts to millions of dollars.

To combine the protective and decorative qualities it is necessary to have in mind besides those things which will lend beauty, some knowledge of how they must be applied in order to promote the life of concrete and at the same time insure maximum service. Unfortunately, in obtaining the desired decoration, frequently at the lowest possible cost, the proper methods of application are sadly neglected. Furthermore, it is only within the past ten years that the matter of treating concrete has been brought so forcefully to the attention of the painter. Concrete is recognized today as the building material of the future. It is recommended by its cheapness and ease of handling, and the one objection raised regarding its dark and gloomy appearance will within a short time be overcome by proper paint coatings.

To understand the problem confronting the decorator, it is necessary to study the properties of the important constitutents of concrete, in order to determine how certain conditions affect the stability of the structures.

Sand, stone and water, all in widely varying proportions, when used togethed with cement, form the basis for concrete. There is nothing in the chemical composition of any of these materials, but the last, which is of extraordinary importance. Cement in its natural state contains about 62 per cent of quicklime, a portion of which remains in the finished concrete in this form. This material, characteristic of all alkalies, has a saponifying action on fatty oils and hence must be given careful scrutiny. In fact, it is the one substance which makes it possible to obtain perfect results by using the ordinary mixed paint without first preparing the surface.

It is universally granted that the nature of concrete construction makes decoration necessary. A few years ago, the statement that it is advisable, if not necessary, to protect concrete, was debated. This is true less frequently at the present time, because recent developments and a close study of the natural forces at work indicate that deterioration, while not readily apparent, is constantly going on, nevertheless.

Concrete is very porous. Its permeable properties are indicated by the ease with which water filters through. It also possesses absorptive properties, and is capable of taking in large amounts of moisture. The expansive and contraction resulting from the frequent absorption of water has a weakening influence. This is shown by the rapid disintegration of concrete structures subjected to this condition.

A wide variation is noted in the absorptive and permeable properties of concrete. These factors are governed considerably by the density of the mix. A concreate containing a large percentage of cement will not allow as much water to filter through as one containing a less amount. The

*A committee report presented before the Master Car and Locomotive Painters' Association.

proportions of sand and stone, as well as the size of both, radically affects permeation. Capillarity decreases as the age of concrete increases. These conditions may well be borne in mind when the filter is applied, as they assist in determining the consistency of a filler which will afford the best results.

A large number of so-called waterproofing and damp proofing compounds have been made the basis for considerable investigation. Practically all are recommended to be incorporated in the concrete. By far the largest proportion have proven worthless. The results obtained from several, however, are such that it is possible to predict waterproof concrete by this method of treatment. The water taken in, by a block made with the highest developed type of waterproof compounds, was only 5 per cent of the amount absorbed by an untreated block made with the same raw materials.

Repeated experiments have shown that the addition of the present types of waterprooofing compounds are likely to result in a weakening of the structure. It is impossible, however, under certain conditions, to otherwise treat the concrete, and in many instances the results of concrete made with waterproofing compounds in combination, when used in sewage systems, drainage plants, etc., has proven superior to the wear of concrete made in the ordinary manner. Furthermore, gradual development along this line will no doubt solve the problem, and the addition of some excluding agent will afford moisture proof concrete and at the same time, instead of proving harmful, will be beneficial as regards the strength of the structure.

Such defects as staining and efflorescence caused by the exudation of water soluble salts being deposited on the surfaces upon the evaporation of the moisture will be prevented by eliminating the permeable properties of concrete.

Considered from a sanitary standpoint treatment which will eliminate permeation and absorption of moisture is highly desirable, and this feature is alone sufficient to warrant the treatment of passenger car concrete floors. The evil effects of a damp floor are common enough to require no further comment.

The disintegrating action of gases prevalent in the atmosphere has by careful test been proven to be considerable. The gradual deterioration is first detected by the appearance of small checks which develop "crumbling." This is soon followed by large cracking, which extends in no definite direction, and which is due no doubt to the results of forces acting in unison with the gases.

What has been said concerning the results obtained from the incorporation of materials in concrete in order to obtain waterproofing properties is true to a great extent regarding the addition of materials which give decorative qualities. Early disintegration has frequently occurred from the use of improper coloring matter. The colors which have proven the most successful are natural earth pigments, which are practically inert, and therefore exert no chemical action. To obtain brilliance, water soluble dyes are occasionally added, and they have so far shown no harmful effects. The former are to be preferred, however, if the desired color can be obtained, as they are fast to light, while the stains will invariably fade. It is advisable when contemplating finishing concrete in a color to write the suppliers of the cement. They are best capable of advising as to the coloring materials which can be safely used.

The absorption of grease and oil not only tends to disfigure a floor, but some of the best authorities on concrete construction are of the opinion that a considerable number of these materials have a disintegrating action. Many types and grades of mineral oil when allowed to penetrate into concrete that was not thoroughly dry were found to possess a disintegrating influence. Tests made on old surfaces did not show any noticeable indication of deterioration, however.

The incorporation of linseed oil in a concrete mix proved that it was impossible by this means to waterproof or make the concrete impervious to the absorption of oils. The results of these tests were substantiated by leading engineers connected with several large railroads who were interviewed as to the nature of the investigation they were conducting regarding the treatment of concrete floors.

By the absorption of grease and oil, spots are formed, where dust and disease germs collect and breed. As nothing has yet been found which when added to concrete will correct for the absorption of oil, it is necessary to overcome the difficulty by painting. It happens many times that where a floor is put down in a body layer and a finish coat that the surface concrete will be loosened when subjected to the continued action of penetrating oils. This same condition is frequently caused by abnormal permeation, although the defect is overcome to a great extent if the surface layer is laid down before the lower has taken its "initial" set. As the floors in passenger cars consist of one layer the danger referred to above need not be anticipated.

One of the most undesirable features connected with concrete floors is the continual "dusting," which is caused by the natural grinding action of wear on the surface. Wherever the floor is subjected to hard usage the "dust" may, besides becoming a source of irritation, prove injurious to the health. The "dust" readily adheres to the surface of untreated floors in a manner which makes it impossible to remove. Sweeping tends only to aggravate to a certain extent the tendency of "powder," as many small particles are loosened or torn away.

By painting the floor is made sanitary because it can be kept clean and free from all traces of dust and dirt. All opportunity for "powdering" is overcome by the thin film of paint which, when properly applied, has a firm hold within the mass of concrete, and besides eliminating the possibility of surface wear makes an impermeable coating which completely retards the absorption of moisture. This coat will withstand the action of forces which would readily disintegrate the untreated concrete. Oils and grease are kept from penetrating into the concrete. As regards the finish, outside of natural wood stains, it is possible to obtain the same color and decoration on concrete floors that is to be had by the painting of wood.

Knowing that lime has a saponifying action on oils, and furthermore, in cognizance of the fact that all concrete contains alkali in varying amounts, the first matter to consider is how to treat surfaces in order to either eliminate this material by neutralizing it, or in some manner to keep it from exerting its harmful influence on the vehicle portion of the paint which is to be applied. A treatment which has for its object the elimination of whatever free alkali is present on and near the surface will in practically every instance prove injurious to the concrete. The use of mineral acids while neutralizing the lime will detract from the life of the structure. Solution of materials which change the lime to insoluble salts which do not act on oils have been suggested from time to time and have been used with varying success. The general results of experiments along this line indicate, however, that it is not advisable to attempt the elimination or change of the alkali, to some other form, by chemical reagents.

The most satisfactory results up to the present time have been obtained by the use of a thin varnish-like mixture which is especially adapted for work of this character. This filler is practically a wash which penetrates into the con-

crete and destroys whatever action alkali would have on an oil paint coat. In the process of neutralizing any free alkali with which this filler comes into direct contact products are formed which assist in making a thorough bond within the concrete, without weakening the structure. Capillarity is destroyed by the oxidized film, which results upon drying. This makes the passage of moisture through the paint coat impossible. The paint coat which follows the filler can then be selected to obtain the desired decoration and will assist in correcting for all the forces that exert deteriorating influences on naked concrete.

In applying the paint two factors must be given careful attention. While the pigment is a requisite of considerable importance, the vehicle will in almost every instance determine the wearing properties. Floors are subject to hard usage and must withstand severe strains. It is necessary therefore to use a material which will oxidize to a hard dry film and at the same time retain sufficient elasticity to withstand the strains to which it is exposed.

The material best adapted for this kind of work will not alone give satisfactory results. It must be applied in a manner which will insure a thorough bond in the concrete itself. Ordinary floor paints which prove satisfactory when used over wooden surfaces give equally as good results when used over a properly applied filler. The wear closely resembles that found on a wooden floor. The paint coat invariably possesses somewhat better bonds within the concrete and the service in many cases is superior to that obtained from the same paint applied on wood.

Paints which are made especially for concrete floors show improved wearing properties when applied over a filler. This condition was found to be true with all materials tested. Considering that the vehicle which determines the service value of a paint is acted upon by the free alkali present in concrete, and with the knowledge that up to the present time all those vehicles which give good results are saponifiable, it is easily explained why paint applied over a surface which has been treated to correct for the alkali will give better results than if certain portions of the paint, must, wherever necessary, neutralize the objectionable forces at work when as a natural consequence in so doing the bond is weakened or broken in places.

As in the case of other painting, one of the most important factors in connection with good paint service consists in the proper preparation of the surface and the correct application of the material. Before applying the filler, care should be exercised to lightly brush away all dust and loosely adhering particles of concrete. If the surface is very hard and smooth it may be necessary to go over it thoroughly with a stiff wire brush, as otherwise the penetration will not be sufficient to allow the paint coat to form its hold within the concrete, with the result that flaking will soon follow. At no time is it advisable to use water in cleansing the floor in preparation for painting. Because of the tendency that concrete has for holding moistures, it requires a long time to thoroughly dry out. Peeling is likely to result if the floor is not dry at the time it is treated.

Wherever possible the floor should be allowed to stand for three to five weeks so as to give the concrete ample time to dry out. The evil effects obtained by the presence of alkali in the concrete are also lessened when the floor is allowed to stand for some time. In most cases it is possible to allow passenger car floors to stand because of the time required to complete the building of the car and its decoration.

When painting floors which have any grease or oil adhering to them it is necessary to carefully wash them with benzine before applying the filler, otherwise it cannot perform its proper functions. If any neglect occurs in this respect the paint coat which follows will, because of the lack of penetration, soon break away in the form of "scaling."

Frequently concrete floors are encountered which do not dry out evenly, or which show a variation in hardening, due to unevenness in the size of the particles of sand and stone. If a paint coat is applied without first treating the surface with a filler, the finish will lack uniformity and show gloss spots. The use of a filler makes certain a finish which is even in appearance.

While it is true in other branches of painting that the application of several thin coats is preferable to thick coats, this method of application is even more necessary for the painting of concrete floors. While good results can be obtained from the application of one coat over a filler, the best service value is given where two coats are used, the first especially being applied thin.

In applying a filler care must be exercised so as not to obtain a varnish-like surface, which may result from a too heavy application or in many cases can be traced to the character of the concrete. When properly applied the filler penetrates into the concrete and when dry the only thing that would indicate its application is a slight staining effect. No gloss should be perceptible. If the surface left after the application of the filler shows a glossy appearance, the results obtained by applying a paint coat over it will in most cases prove unsatisfactory. In case a too heavy application of the filler has been made, it should be cut with turpentine before applying the paint.

Tests made over a heavy varnish-like filler have shown results less satisfactory than where the paint was applied on the floor direct, where it is subjected to the action of the alkali in the concrete besides the surface wear.

Natural wear will gradually make necessary the repainting of floors. It is not necessary to again apply a filler. One coat of paint applied so that it can be brushed out well will give the best results. In preparing the surface for repainting no strong alkali should be used for cleaning as it will not only act upon the paint, but if not thoroughly removed will also affect the following coat. It is advisable to go over the surface with warm water and soap and allow sufficient time to elapse for drying.

A study of a large number of concrete surfaces indicates that many times the concrete itself may be the cause for early disintegration. This is especially true of incorrect mixtures and quick-setting cements. Many engineers are positive in their statement that the cement in many instances has been the cause for early disintegration. At the present time tests are being conducted in order to determine whether the explanation of certain types of disintegration is not in a great number of cases due to the character of the concrete. There are many factors which will modify the service of a paint coat, and the mechanic who desires to excell in the treatment of concrete passenger floors must give the subject close study. In this manner, what is today considered a "specialty" will within a very few years stand as the highest type of development regarding the satisfactory treatment of the new type of construction which is generally coming into general use.

IN TROPICAL COUNTRIES where the feed water is usually hot, feed pumps are often preferred to injectors, as they are considered more reliable in the hands of unskilled men. At times, in India, the water in the tender tank gets too hot to bear the hand in it, and many of the latest engines are equipped with steam pumps placed in an accessible position on the running board along side the firebox.

ELIMINATING TENDER DERAILMENTS.

By J. J. Clark, M. M., Tennessee Central R. R

As stated in my communication on page 493 of the October issue of the *Railway Master Mechanic,* we passed through a period of tender derailments on our road a couple of years ago, but by making a number of changes in tenders I have practically eliminated derailments. The tenders referred to were practically new from the locomotive works and for use in both freight and passenger service. There were three changes made on the trucks, namely: the shape of center casting, top and bottom, the clearance and location of side bearings and change from outside to inside hung brakes. The trucks of the tenders referred to are arch bar trucks carrying double elliptic springs, wheel base of trucks, 4 ft. 10 in.; total wheel base, 15 ft. 3 in.; height from rail to bottom of cistern, 4 ft. 2½ in.; from the rail to the top of coping, 10 ft. ½ in.; capacity, 5,000 gallons of water, 11 tons of coal; weight of tender complete, 100,000 lbs.

As previously stated, at one time before the changes I have mentioned were made, it was hardly possible to get an engine over the road without a tender derailment, and there was hardly a day for a period of about six or eight months that we did not have a tender derailment. Incidentally, I would state that I do not use splash boards to stop the motion of the water inside the cistern, as I do not consider them of any benefit whatever.

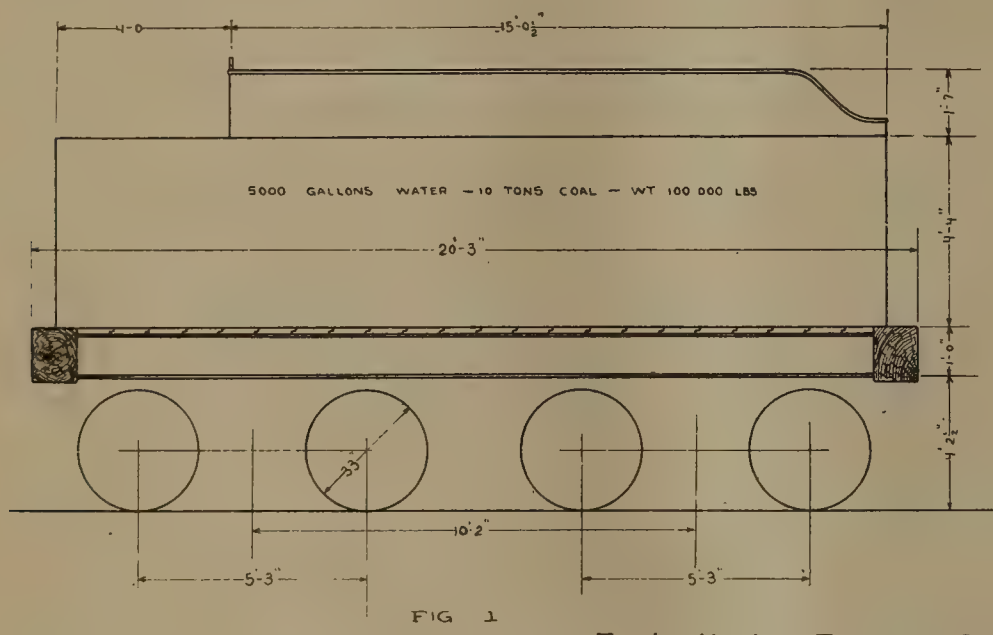


FIG 1

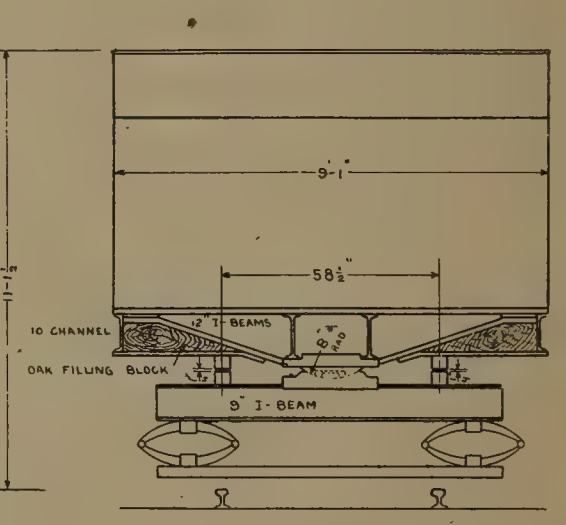


FIG 2

Tender Used on Tennessee Central R. R.

Figure 1 shows the general dimensions and outline of the tender I am using. Figure 2 shows the general construction of trucks and frames. Figure 3 shows the old design of center bearing, a flat bearing, as it will be noticed, 12 inches in diameter.

The location of the side bearings in Figure 3 is somewhat exaggerated for convenience of explanation. Figure 4 shows what was resorted to before success was obtained in keeping the tenders on the rail. Figures 3 and 4 show the action of force and resulting effect. Figure 3 prior to changes had outside hung brakes, flat bottom center casting, and side bearings directly over each spring.

In Figure 3, for convenience, we will call the weights "W"; plus "W" for weight increasing toward the rail, and minus "W" for that tending to leave the rail, or be transferred to some other place.

We will call the force due to motion of tender taking curve "F." Figure 3 is on any ordinary curve, with load where it would be on this style of arrangement at moderate speed.

To determine the action of these weights and forces, we will start with the load. As soon as the tender takes the curve, the load is shifted to inside of curve, due to the elevation of the outer rail, which acts as a prop against the force "F." As the load shifts toward the inside of curves it bears heavier on center bearing at "X," Figure 3, and lightens proportionately on opposite side of center bearing, at the same time the force "F" acts against the flange of center bearing at "P" and tends to lift as the weight changes. This combined action throws the greater part of the weight on side bearing inside of curve, and as the side bearing is near the end of bolster, it is given the maximum amount of leverage against the inside rail. This is added weight applied to the inner journal, and produces a proportionate weight on the outer rail. In other words, we still have the outer rail to serve as a prop against the force "F," but have not sufficient weight on the outer wheels to overcome the friction of flange of wheels against the rail, hence the outer wheel climbs the rail, which is the natural result.

This style of center bearing produces a combination of frictional resistance, which retards the free movement of the truck in curves, due to load shifting from one side of center to the other, and in a case of reverse curve the strain is very severe.

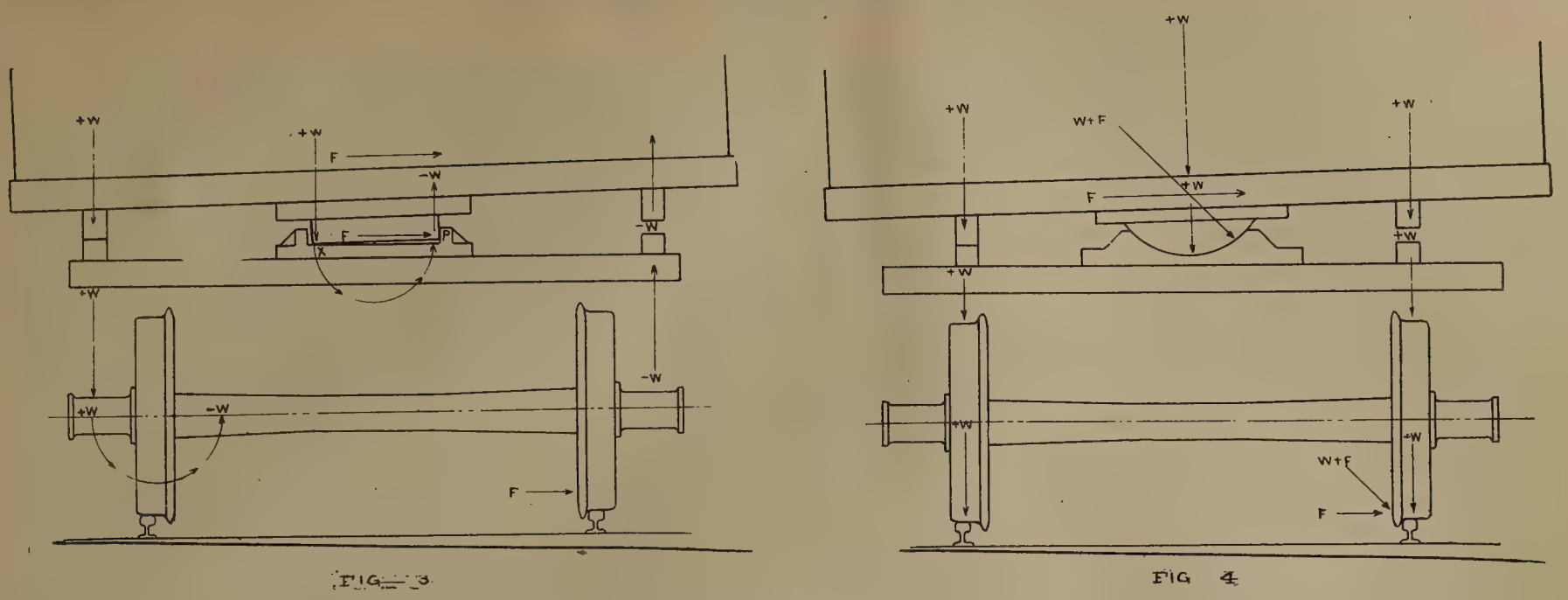
In Figure 4 we have adopted the spherical center bearing, and placed the side bearings directly over the rail, allowing them about ¼-in. clearance.

The center casting, as you will note, is made with an 8-in. radius, with a cross sectional surface, and the diameter at the extreme point is 12 in.

Let us trace Figure 4 through the same process of force as we did Figure 3. The tender has taken a curve, same as Figure 3, but instead of the weight being shifted to one side, it still remains at the center of the ball, and is equally distributed over its bearing surface. The equalization of weight is always at the center, and force "F" acting at right angles with same, produces the combined force, and weight acting in the common direction toward the outer rail. As the side bearings are directly over the rails, there is no leverage whatever. Additional weight that may come on the inner side is transmitted direct to the rail.

Figure 4 in the diagram does not show any weight on the outer side bearing, as the center bearing practically carries all the weight; the side bearings showing scarcely any wear in service. We use the common flat surface side bearing; no roller or frictionless bearings being used. There is not the frictional resistance in this center bearing that there is in the bearing shown in Figure 3, as the bearing is always centered (that is, the load is equally distributed), with the trucks or load in almost any position of service.

When the combined weight and force are applied at the rail, they tend to bear down on the wheel and overcome the flange friction, and as they act together, the more flange friction we have the more weight there is in proportion, hence neither speed nor curves affect this tender, within reasonable limits, so far as keeping on the rail is concerned.



Showing Action of Forces with Flat and with Spherical Center Bearings.

A close study of the two diagrams and Figures 3 and 4 should convince any one of the merits of the center casting in question. Experience in actual service, I believe, should prove out my theory to be correct, at any rate, as soon as the changes were made in accordance with Figure 2, derailments were eliminated.

LOCOMOTIVE ENGINEERS' WAGE DECISION.

Declaring that a case has not been made for an advance all along the line in the compensation of locomotive engineers, the Board of Arbitration, before which the railways and engineers presented their cases in July, handed down its decision November 25. The board fixed a minimum wage in passenger service of $4.25 per day, and $4.75 for through freight service. The engineers had asked for $4.40 and $4.60 (according to the size of the engines) in passenger service, and for as high as $5.75 for freight service.

The arbitration board as appointed by the Chief Justice of the Supreme Court, the United States Commissioner of Labor, and the presiding judge of the United States Commerce Court, consisted of Oscar S. Straus, of New York; Charles R. Van Hise, of Madison, Wis.; Albert Shaw, editor of the "Review of Reviews"; Frederick N. Judson, of St. Louis, and Otto M. Eidlitz, former president of the Building Trades Association of New York City. The railways were represented on this board by Daniel Willard, president of the Baltimore & Ohio R. R., and the engineers by P. H. Morrissey, former grand master of the Brotherhood of Railroad Trainmen.

The report of the board was unanimously agreed to by the five members appointed by the Chief Justice of the Supreme Court, the United States Commissioner of Labor and the presiding judge of the United States Commerce Court. It was signed by Mr. Willard with an explanatory statement. Mr. Morrissey filed a dissenting opinion.

In an explanation of its decision, the board said: "In fixing the minimum wage in passenger service at $4.25 per day in the eastern district, a higher minimum rate is established than that which now exists on all but a few of the roads. In awarding a minimum through freight rate of $4.75 per day, a rate is established that measurably approaches the current minima on roads now paying the better rates."

With reference to the standardization of wages asked for by the engineers, the decision says: "The board feel that at the present time it has gone as far toward establishing a uniformity of pay as is practicable by introducing a minimum wage for each class of service."

The practical effect of the decision on these two important features of the engineers' demands is that as a general rule the poorer paid of the engineers are brought up, while those receiving the higher wages will not be affected to any appreciable extent.

While stating that they should not deny an increase of compensation to the engineers on the ground that the roads are unable to pay, the board says, "if they are not able to pay such compensation with existing rates, there is just cause for them to open again the question of an increase of rates with the Interstate Commerce Commission."

With reference to electric service, one point on which the railroads laid much stress in the hearings before the board, the decision says, "since the use of electric locomotives or multiple unit trains upon steam railways is in so early a stage of development, and there is as yet no approximation to stable conditions, but a wide variation in existing practices, the board found itself unable, from the evidence before it, to make any uniform rules regulating rates of pay and conditions of service for engineers or motormen employed on such trains." In other words, no change is made in existing working rules and conditions, though the minimum day's wage of $4.25 in passenger service is awarded the engineers.

With reference to the right of engineers to man electric service, the board says, "wherever electric service is installed as a substitute for steam, or is now in operation on any of the railroads parties to this arbitration, or on any of the tracks operated or controlled by any of them as part of their systems, the locomotive engineers shall have the preference for the positions of engineers or motormen on electric locomotives or multiple unit trains; but this right of the engineers shall not operate to displace any man operating electric power on any of the railroads parties to the agreement on May 1, 1912."

This decision, containing as it does, the words "as part of their systems," would seem to uphold the principal contention of the railways in this matter, in that the carriers argued that while it was their practice to give preference to the locomotive engineers in choosing men for engineers and motormen on electric locomotives or multiple unit trains, they did not want to be prevented from making any contractual relations from time to time in leasing properties, by being obligated to guarantee employment to the engineers who might be employed on the line leased either to or from some other party.

As far as the public is concerned, by far the most important feature of the board's decision is a recommendation for "the creation of national and state wage commissions or labor commissions, which should exercise functions regarding labor, engaged at work in public utilities, analogous

to those now exercised with regard to capital by the public service commissions already in existence."

The board says "from the view point of the public it is an intolerable situation when any group of men, whether employes or employers, whether large or small, have a power to decide that a great section of the country, as populous as all of France, shall undergo great loss of life, unspeakable suffering and loss of property beyond the power of description, through the stoppage of a necessary public service."

That the board considered the general labor proposition presented by the engineers' case of far more importance than the amount of money involved, is indicated by its statement that "the amount of money involved, while it is very large, is far less important in the eyes of the board than the public interests."

The board says that it does not hold "that the advance in pay to organized labor has been too frequent or too large, but merely that the question of advance for a given class of labor engaged in work upon the public utilities should not depend upon organization, but upon justice. Especially for the public utilities is it important that labor should have a just wage, and if the existing wages are not adequate they should be increased. If the increase in wages places the public utilities in a position that does not enable them to secure a fair return upon capital invested and maintain a proper reverse, they should be allowed to increase their rates until they are in that position. In short, the public utilities should not impose an undue burden upon the public by paying higher wages than are reasonable, nor should the public receive services from the railroads at a rate so low that labor does not receive fair compensation and capital its fair return. How important this statement is will be understood when it is appreciated that of the gross earnings of the railroads of the United States as a whole, excluding officials, over 42 per cent goes to labor and on the fifty-two railroads involved in this controversy, over 45 per cent."

"If the arguments above presented are sound," the report continues, "there seems to be no way to obtain justice for the three parties concerned, the railway companies, the railway employes and the public, in the matter of wages except to have a permanent board which shall have the problem of adjustment and maintenance of justice for the three parties continually before them.

"It is believed that if the plan of wage commissions were adopted it is probable that railway employes would not have a just ground for a strike, and this fact combined with the power of the law and public opinion, would render a strike extremely unlikely in the future."

In concluding, the report says, "Finally, it is the belief of the board that in the last analysis, the only solution—unless we are to rely solely upon the restraining power of public opinion—is to qualify the principle of free contract in the railroad service. A strike in the army or navy is mutiny, and universally punished as such. The same principle is applied to seamen because of the public necessity involved. A strike among postal clerks, as among the teachers of our public schools, would be unthinkable. In all these cases, the employment, to borrow a legal phrase, is affected with a public use, and this of necessity qualifies the right of free concerted action which exists in private employments.

"However, if the principle be accepted that there are certain classes of service thus affected with a public interest and men who enter them are not free concertedly to quit the service, then these men must be guarded in the matter of wages and conditions by public protection; and this it is believed can best be done through on interstate wage commission.

"It is well understood by the board that the problem for which the above plan is a suggested solution is a complex and difficult one. The suggestion, however, grows out of a profound conviction that the food and clothing of our people, the industries, and the general welfare of the nation, cannot be permitted to depend upon the policies and the dictates of any particular group of men, whether employers or employes, nor upon the determination of a group of employers and employes combined. The public utilities of the nation are of such fundamental importance to the whole people that their operation must not be interrupted, and means must be worked out which will guarantee this result."

THE CAR DEPARTMENT.

By Louis Brentnall.

Of the several departments under the management of the master mechanic, the car department requires the most careful organization; in fact, the whole efficiency of this department depends upon its being well organized.

It is generally beyond the official function of the master mechanic to handle details relating to his car department to any further extent than he does those concerning his locomotive department; his position being managerial and advisory, rather than one burdened by petty supervision. Ordinarily, the management of a railway company does not look upon a master mechanic as a working foreman, and were such a condition to exist in some isolated instance it would likely be through the fault of the master mechanic himself, as by his preferring to use his hands instead of his head.

Therefore, as an officer of a railroad company upon whom the management depends for technical judgment relating to shop work and the supervision of foremen, the master mechanic should so organize his car department that it will take care of its own details relating to cars, in the matter of inspection, repairs and billing.

In matters requiring special judgment or in the issuance of official instructions, the master mechanic should give his car department such superintendence as it demands, keeping irregularities under surveillance until righted, and requiring that correspondence with other officers pass through his office for scrutiny and official signature, in order to overcome possible misunderstandings or ruptures.

Among the features which help to make the car department an ideal one is its personnel.

That the men comprising the car department should be experienced in car matters is of first importance. Each man should fit his position, instead of the position being made to fit him. The personnel of this department is generally made up as follows:

A general car foreman, having general supervision over the department and held responsible by the master mechanic for everything pertaining to it.

A sub-foreman, in charge of workmen on car repair work. There may be several of these, as one in charge of truck work, another in charge of car body work, and so on. Each of these should be thoroughly conversant with his specialty.

A head car inspector, with as many assistants as needed, as one in charge of depot train inspections, another in charge of passenger car repair inspections, another in charge of the inspection of freight cars being set for repairs and listing the defects for sub-foremen or car repairers, to insure complete repairs—the number of inspectors depending, of course, upon the size of repair point or the number needed to insure efficiency.

A car repair bill clerk, who should be one with some executive ability, and be given one or two assistants. The reporting of car repairs may be made to him on cards,

various ways of keeping record of car repairs, but this should be done at the time the work is performed, either by a sub-foreman or an assistant car clerk.

In these days of a brisk freight business and with hundreds—even thousands—more cars being handled than in the olden times, special car men are oftentimes needed, as: a traveling car inspector, a traveling car foreman, a traveling car clerk, etc. These men should not only be familiar with their special duties, but they should be organizers, capable of lining up the handling of car work at outside repair points.

With the personnel of this department made efficient with experienced men, as mentioned above, the duties of each man should be thoroughly defined—made a matter of record if necessary, and each man depended upon and held responsible for the proper performance of his duties. From time to time, the heads of the car department may be required to make special reports pertaining to the betterment of some particular feature relating to the department. New repair men or car clerks require teaching, consequently matters pertaining to car repair education—especially as to how work should be done and billed in accordance with the code of rules of the Master Car Builders' Association. This book of rules governing the inspection, repairing and billing of cars now contains so many items that the only way to master its instruction is by studying the book from cover to cover, from day to day, while actual repairing and billing is going on. The Arbitration Committee of the M. C. B. Association has rendered many decisions over disputes relating to billing for car repairs between different railroad companies, and these books of decisions should be in the car department, as well as the code books. There are also a goodly number of reference books relating to car repairs, which give weights of different materials, sizes of materials, prices of specially manufactured car materials, tables for reckoning different sizes of lumber, depreciation tables, etc., all of which facilitate the efficient handling of repairs and billing.

There should be a tendency in the direction of promoting men from the repair track to minor official positions in the car department, as well as promoting inspectors to positions as foremen, and clerks to head clerical positions. It has been said that the car department is the hardest place to keep good men. No sooner does a man become a good inspector or a first-class bill clerk than he gets something better from some other road, thereby keeping the department more or less disorganized by having to break in new men. A "step-by-step" promotion plan will no doubt help to keep some of them. Favoritism of certain workmen to the detriment of others is generally bad policy, consequently promotions should be along some well-defined line for the benefit of all concerned. While railway management may require a stiff rein on expenditures, at the same time the car department should be reinforced on some railways, for the reason that reimbursement is received for repairs to foreign cars made on account of owners' responsibility. This is a monetary feature which prevails with few other departments outside of the traffic department which has its representatives galore.

An inefficient organization in the car department allows many billable items for car repairs to escape notice. Most master mechanics are diligent in requiring that repair cards be made for every billable item, but when it comes to tracing foreign roads to ascertain if they did not make certain wrong repairs to the company's equipment, and for which their defect cards should be issued, the matter is apt to be left with some other the division without brassing or packing a box. All of this, mind you, can be brought about by intelligently taking care of journal-boxes.

The lubrication of locomotives is perhaps the most important —for on the engine depends whether the train arrives at its department to handle, which in turn refers it to still another department—neither of whom may know how to handle the transaction, and finally the papers are allowed to pass to file as the easiest way of disposing of the case. All matters referring to car repairs, billing and tracing, should be handled in one office or under one head, where the technique of the work is well understood, instead of part of it being handled by the car department and the rest of it being referred elsewhere, which one might say is equal to referring it nowhere. Outside of their own departments officials may have but a meager comprehension, consequently all matters referring to one thing should be handled by one department and its subordinates, which brings us right back to where this paragraph opened—that a car department loses money where the master mechanic does not require it to handle everything pertaining to car matters, instead of referring some of it to some outside official whose duties are foreign to the car business.

More items having a money value can be overlooked in the car department than in other departments, and it behooves the master mechanic to strengthen his car department organization all possible.

LUBRICATION.

By C. M. Starke.

Lubrication in itself is one of the most important subjects with which any railway has to deal; lack of it is just as expensive and perhaps more so, than too much, and the early education of every employe who has anything to do with oils is the most economical effort the company could put forth toward a future saving.

Being connected with railway work, in the mechanical department, my remarks are necessarily confined to the operation of trains and shop machinery, and in order to further interest myself in behalf of my employes, I have taken a special interest in this subject, realizing that thousands of dollars are spent annually for lubrication, and that a 4¼x8 journal-box on a car should receive the same careful attention that a driving-box cellar should on your high-class passenger engines.

In so far as packing boxes on cars is concerned, I would suggest that each of you personally inspect a number of journal-boxes on your repair tracks, and you will invariably find an immense quantity of surplus packing, in fact enough dope can be removed from one car to pack another. Your truck packer should be taught that the end of the journal has no bearing; neither has the top of the brass; but that the packing should be pushed well up under the journal so that in every revolution it will come in contact with the full bearing surface of the journal, and thus insure perfect lubrication. The surplus dope removed from cars on the repair tracks will soon run up into hundreds of pounds; this should be picked thoroughly, placed in a soaking vat, then placed on a drain board, where it should be allowed to remain for twenty-four hours, in a temperature of 125°. Your surplus dope is again ready for use, and you have saved for your company many pounds of waste and gallons of oil.

Another important feature of car lubrication is the attention that must be given journal-box lids, which should always fit up close to prevent dust and gravel getting in. With proper attention from the car force, delays due to hot boxes on freight cars would soon be reduced to a minimum. Your stock of brasses in the store house would accumulate; your cost per thousand miles for oiling cars would be considerably reduced; your division superintendent would smile; the trainmaster would be tickled and the train crew would enjoy unbounded happiness in the knowledge that they had good chances of getting over sheets or in book form, but whatever the form, it should contain a complete record of the work done. This report should be reviewed by him daily in order that he may interview the car foreman in case of any incompleteness in the record from which to make repair cards. There are

destination—and an engine failure is a discreditable reflection on the mechanical department.

In the first place, the engineer should be provided with good supply cans; to have the oil in the cans where it can be used is much better than having the bottom of the can rock and the tank boxes filled with valve, signal and engine oil. Assuming that in most cases the cans are removed from the engines on arrival at terminals, it should be the duty of the man who removes the cans to see that they do not leak and that they have screw tops, instead of a wooden plug or waste stopper. Ten minutes tinner work will usually put them in good shape and save quantities of oil. When the allowance of oil is placed in the cans, they should remain in the oil house until the crew is again called for duty. Enginehouse men seem to prefer getting it from the supply cans on an engine to drawing it on requisition from the oil house; the result is that when the engineer reports for duty his supply has vanished, the oil-house man insists that he put it in the cans, which show that it is not in them, and in order to get him out on time, an additional supply is given him, for which there is no legitimate charge, without you pad your monthly oil statement.

Some engineers are very indifferent in the use of oil, but this indifference can usually be overcome if the general foreman will lend his assistance, and any interest manifested by the master mechanic would also be convincing evidence that it was worth while.

The cost of lubrication on a railroad is based on mileage of locomotives and cars; tests are made to determine just what amount of valve and engine oil will be necessary to make the round trip, and under ordinary conditions the allowance should be sufficient. There are approximately 6,600 drops of valve oil to the pint, and a lubricator feeding five to six drops per minute should be sufficient to lubricate properly—it requires from five to fourteen minutes for oil to go from the lubricator to the cylinders, and the lubricator should be adjusted at least ten minutes before starting on the trip. If this is done, you can rest assured that your valves will be in good condition at the start and there will be no danger of cutting them.

Engine oil on the running gear should be put at the place where it will do good. Oil holes in the motion rigging should be filled, but not run over, and allowed to drop on the ground. This is the place that a good feed can does the most good.

Nothing is more convincing that oil is being wasted than to walk up a delivery track to the engine house and see the amount of oil that has dropped from the machinery of engines. Hard oil in driving-box cellars and rod cups has proved to be successful as a lubricant. There are many different styles of rod grease cups, and it would no doubt be surprising to some to see the amount of grease that will come from a cup by giving the compression plug one turn. Demonstrating this to an engineer just recently, convinced him that it was unnecessary to screw the compression plug down in the cup until the grease was forced up all around the collar of the crank pin.

Engines equipped with grease cellars should be given a careful inspection at the completion of each trip, and particular attention paid to the indicators. In some cases the perforated plate of a grease cellar will hang and not allow the grease to get up to the journal. This soon results in a hot bearing and perhaps a new brass. When it is found that the cellar is almost empty, then is the time to refill it and not take chances on a hot box because the indicators are not quite up. The engine is more valuable to your company when hauling cars than when on a drop pit. Where a driving box cellar that was formerly an oil cellar has been made into a grease cellar, particular attention should be given the oil holes in the top of the box, and when possible to do so, these holes should be tapped and plugged; if not, the grease will eventually force a driven plug from the hole and thereby waste considerable grease by allowing it to accumulate on top of the box, where it will do no good.

Lubrication of shop machinery is another important feature of this subject—nothing is more noticeable, while passing through a machine shop, than little pools of oil on the floor directly under a line shaft box. This attracts attention and very often criticism of the shop foreman for neglecting to instruct the oiler that "Enough is enough and too much is too much." A viscosity oil has been found to give just as efficient service in a stationary engine as a high grade valve oil, and a noticeable saving is effected by the proper use of this oil in all stationary engines.

There are many different departments of railroading and each has many different operations—consequently some railroads manage some one department or perform some operation more economically than any of the others, and if "Imitation is flattery," let us be imitators if we get results. This is obviously true in every field of human endeavor, and it must be true in railroading.

In conclusion, I wish to say that economy in lubrication should not be construed as meanness. It is the difference between a right and a wrong way of doing things, between success and failure, and I am quite sure that the railroads these days want men who *do,* not men who *hope.—Illinois Central Magazine.*

SHIPMENT OF ELECTRIC LOCOMOTIVES.

Recently an interesting sight was the shipment of ten electric locomotives in the same train across the Alleghenies from Philadelphia to East Pittsburgh. These locomotives are the last ten of an order for thirty-nine, for the New York, New Haven & Hartford R. R., and were shipped to the Westinghouse Electric & Manufacturing Co. at East Pittsburgh to be electrically equipped.

The mechanical parts were built by the Baldwin Locomotive Works. These locomotives are of the twin-motor articulated type and each is to be equipped with eight Westinghouse single-phase railway motors and unit switch control.

Twenty-nine similar locomotives are built and building for the New Haven System.

Large Shipment of American Locomotives.

RELATIVE CORROSION OF IRON AND STEEL PIPE AS FOUND IN SERVICE.*

By William H. Walker, Ph. D.

There are few subjects relating to the corrosion of metals which have received so much attention, or around which there has centered so spirited a discussion, as the relative merits of iron (meaning thereby wrought iron) and steel. The fact that this matter is one still receiving attention, notwithstanding the great volume of accumulated and available literature, is due to a number of causes, among which may be mentioned;—first, that althought the words "iron" and "steel" carry with them a definite idea as to general methods of manufacture and some of the more easily discernible properties, they convey no idea as to standards of value. It is possible to make very poor iron and very good steel, and it is just as possible to make the reverse. Hence, when an investigator compared the corrosion of a poor iron with a good steel, he obtained results which favored steel; when the material under study was the reverse, iron was shown to be the more resistant metal. Second, there is a woeful lack of uniformity of conditions obtaining in many, if not most, of the experiments which have been carried on for the purpose of comparing resistance to corrosion. Some specimens were large, some small; some cleaned of scale, others not; some immersed in deep water, others in shallow water, etc. The corrosion of iron is so sensitve to changing conditions of surface, oxygen concentration, salts in solution, and the like, that only when the most careful preparation is made to maintain all conditions constant, is a comparative test of value. Third, many times opinions are formed and expressed by the casual observer which fail to take into consideration not only the fundamental conditions necessary to accurate comparative work, but also less obvious conditions which make a comparison unreliable. For example, a person may notice the rapid rusting of a cheap grade of steel wire fencing which had originally but a wash of zinc as a substitute for galvanizing, and thus become suspicious of the durability of all steel. Or he may notice holes in a metal roof put up in place of a material known to have lasted a much longer time than the new roof. He concludes that the latter is of less value without having any knowledge of the change of conditions in the locality, class of metal, and the thickness of the new roof, nature and thickness of the galvanizing or other protective coating, and so forth.

"Owing to the proverbial conservation of New England, the introduction of steel pipe has been slower in this territory than in other parts of the country. There is a tendency to pronounce any pipe which withstands corrosion as being wrought iron, while the fact that a pipe corrodes easily is considered by many proof in itself that it is steel.

"To determine what the facts actually are in regard to the relative life of service pipes which have been in constant use for a considerable number of years throughout New England, an investigation was undertaken in which it was proposed to seek out instances where steel and iron pipe had been used together in the same system; and further, where the two kinds of metal were separated in this system only by a coupling. Any influence which the coupling might have would be present equally with the iron and with the steel, while conditions of oxygen concentration, temperature, pressure, flow of water or steam, etc., would be as nearly identical for the two kinds of metal as it is possible to obtain. It was intended also to collect in this way material of known resistance or tendency to corrosion, in order to further test the applicability or truthfulness of the so-called "acid corrosion test." While the majority of the pipe so obtained was from hot and cold water feed systems, enough were selected from live and exhaust steam lines, hot-water and steam-heating systems, etc., to make the conclusions drawn of general application. The investigation was necessarily tedious in that each pipe had to be examined to determine whether it was of iron or steel, and many instances were found that would have served our purpose well, but where it was impossible to remove the pipes from the system. The pipes were sent to the laboratory where they were each split lengthwise into halves, and carefully cleaned from scale and rust by soaking in an ammonium citrate solution, with an occasional brushing. In this way the scale and rust were removed without dissolving any of the iron. An estimation of the extent of corrosion was made by measuring with a micrometer gage the ten deepest pits per unit distance of length.

"The results are a splendid vindication of the principle that if oxygen be excluded or taken from water, no corrosion will take place. When the water in the lines examined was stagnant, as in fire-sprinkler systems for buildings, or in lines where the water was circulated over and over again without exposure to the air, as in some hot-water heating systems, no corrosion was to be observed. On the other hand, where fresh water was constantly added to the system, and heated within the system, corrosion was very rapid and in some cases excessive.

"We were able to get sixty-four comparisons of iron and steel where the history of the installation was known. The results are as follows:

Comparisons where iron was found more corroded than steel 20

Comparisons where steel was found more corroded than iron 18

Comparisons where steel and iron were equally corroded.. 9

Comparisons where corrosion was negligible.....17

"These results again demonstrate that taken on the average there is no difference in the corrosion of iron and steel pipe. Conversations held with the engineers in charge of plants during this investigation confirm the statement already made that a pipe is frequently called steel when corrosion is found to be excessive, while it is set down as iron if it rusts but little.

"In order to get some measurement of the influence of oxygen in the water of the modern hot-water supply system, a relatively large scale experiment was carried on at the plant of the Walworth Manufacturing Company in South Boston. Two coils made up from pieces taken from the same length of pipe were each fed with water from the same source at the same temperature. In one case the water was heated to 85 degrees Cent. in an *open tank*, while in the other the water was heated to the same temperature in a *closed* tank. The feed water contained on the average 5.85 cc. of oxygen per liter, and passed through each coil at the rate of one-half gallon per minute. After running 1,750 hours the coil fed with water heated in an open tank had lost 22 gm., while the coil fed with water heated in a closed tank had lost 155 gm. In neither case was the oxygen completely removed; if the water in the open tank had been gently boiled, corrosion in the coil fed with this water would have been entirely prevented.

"In order to show what relation may exist between the so-called acid corrosion test and the real corrosion as found in service, eleven pairs of iron and steel were selected and subjected to 20 per cent sulphuric for four hours at room temperature. Four pairs were selected in which the steel was decidedly better than the iron in service, four in which the iron had shown decidedly better than the steel, and

*Abstract of paper read December 13, 1911, before New England Water Works Association, published in a bulletin of the National Tube Co., Pittsburgh, Pa.

three in which there was no difference between the two metals. In six instances the relative corrosion as shown by the sulphuric acid test corresponded with the corrosion as found in service. In five instances corrosion as shown by the acid test was exactly contrary to that found in service. Although the greatest care was taken to have the specimens of the same size, cleaned in the same way, and in the same physical condition, the results show that no reliance can be placed in this accelerated acid test, but that it may be entirely erroneous and very misleading. Not only did the acid test not agree with the service test when steel was compared with iron, but the steels failed to agree among themselves, and the irons showed no agreement when considered by themselves."

Steel Pipe and Iron Couplings from Indiana Oil Fields, After 15 Years' Service.

The discussion of Dr. Walker's paper was productive of some highly interesting and valuable data. The conclusion of his paper is, "that taken on the average there is no difference in the corrosion of iron and steel pipe."

There still exists in certain localities the belief that wrought iron rusts less than steel. The author points out the most probable reason for this condition when he states: "There is a tendency to pronounce any pipe which withstands corrosion as being wrought iron, while the fact that a pipe corrodes easily is considered by many proof in itself that it is steel." It is not difficult to understand this discrepancy between opinions and actual facts when we consider:

1. How few who hold to this opinion (*i. e., of the superior durability of wrought iron*) base it on anything more than what they have heard others talk of, whose experience frequently amounts to nothing but general observation or inference from results of what they have seen with iron or steel products other than pipe, from which it is unfair and misleading to draw comparison.

Confusion of opinion has resulted from treating the question of corrosion too generally. We cannot compare all kinds of steel as a class with all sorts of wrought iron. We are just beginning to learn that well-made sound steel is not only as durable as the best wrought iron on record, but for special conditions, for example, where acid con-

Steel. Wrought Iron.
Comparative Corrosion of Adjacent Hot Water Supply Pipes.

ditions prevail, steel may be made so as to be many times more resistant than iron.

2. From the demonstrated fact that the majority of those handling pipe day by day are half the time unable to distinguish wrought iron from steel.

3. That corrosion conditions are generally much more severe nowadays and have become more so, much in the same ratio as the relative proportion of steel pipe has increased, so that it would only be natural to connect the more general use of steel with the observed decrease in useful service of pipe in certain localities.

4. The important influence of the man who handles the pipe, who not infrequently prefers wrought iron as being somewhat easier to thread with the average die.

While Dr. Walker's investigation was probably the most thorough of its kind ever made, the results of four similar researches within the past two years are on record. In the first place Prof. Ira Woolson investigated the corrosion of the hot water piping in the New York City bath houses. Eighty-nine samples of pipe were secured, seventeen of which were wrought iron. The corrosion of the two classes of pipe was reported as practically equal.

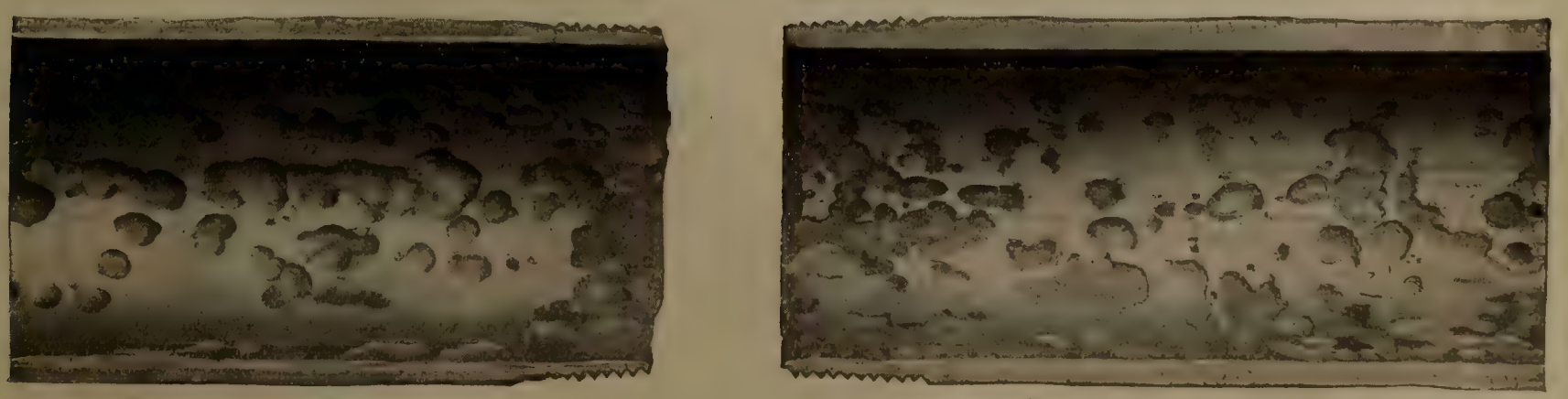
A similar investigation was made in the boiler feed water lines of the Frick Coke Company, Scottdale, Pa. Here was an entirely different class of water in a different locality. The relative corrosion was found to be 100 in the case of wrought iron as against 96 in the case of steel. The average depth of pitting in 21 lots, including iron and steel samples, was .112 of an inch in the wrought iron and .108 in the steel. In all these investigations there was found for the same length of exposure a very considerable difference between one sample and another, as much as 25 per cent one way or the other, but on averaging up a sufficient number of samples in the same system, or in different systems, and making comparison, the results came out exactly the same as Dr. Walker found in New England.

A third investigation in the Cresson coal fields of central Pennsylvania with water of various characters leads to much the same conclusion, although the steel pipe had some advantage in this case—100 for the wrought iron against 85 for the steel.

Later still a detailed examination was made of the corrosion of the hot water supply lines in the Allegheny General Hospital at Pittsburgh. This pipe had been installed for seven or eight years when it was decided to remove the entire system. By arrangement with the architects a sample was secured from each length of pipe as it was taken out, leaving a portion of the length with the architects for independent examination. Out of the 69 samples taken from the hot water systems, 42 turned out to be wrought iron and 27 were steel. The average depth of pitting in the wrought iron was .092 of an inch and in the steel .094 of an inch—practically the same again.

The comparisons of wrought iron and steel shown in these five investigations are all from lines where the corrosion was on the interior of the pipes and where the conditions are clearly more uniform and constant from pipe to pipe than in other kind of service. However, the two materials behave much the same when subjected to exterior corrosion as indicated by the many cases of rusting alternate lengths of iron and steel casing and of steel pipe with iron couplings from the Ohio and Indiana oil fields and elsewhere. The inevitable conclusion is that wrought iron and steel pipe under the same conditions of service are equally durable.

This conclusion of Dr. Walker was attacked on the grounds that the comparisons of the relative corrosion of iron and steel pipe were based on "calculations made by measuring the depth of corrosion on partly corroded pipes under observation for a given time and also on the erroneous assumption that the corrosion of both metals would have continued at the same ratio at which it started." It was pointed out that, on the contrary, the samples were from pipe showing all stages of corrosion, which had been in service from two to seventeen years. The experience showed that the same comparisons obtained whether the corrosion was light or otherwise. Moreover Dr. Walker found certain samples "rusted to practical destruction," measurement of the pitting of these being given by him in the following table



Steel. Wrought Iron.
Comparative Corrsion of Adjacent Boiler Feed Water Pipes.

Sample—Number.	Depth of Pitting Mean of Ten Deepest Pits Inches.	Deepest pit. Inches.	Least of Ten Deepest Pits. Inches.
W-10 — Iron	.102	.134	.085
W-11 — Steel	.075	.095	.067
W-22 — Iron	.114	.160	.068
W-23 — Steel	.075	.107	.042
W-24 — Iron	.139	.168	.109
W-25 — Steel	.140	.204	.076
X-15 — Iron	.077	.101	.069
X-16 — Steel	.040	.047	.034
X-29 — Iron	.042	.060	.030
X-30 — Steel	.066	.103	.042
X-49 — Iron	.077	.113	.049
X-50—Steel	.077	.113	.049
X-57 — Iron	.038	.110	.012
X-58 — Steel	.026	.053	.012
X-69—Iron	.113	.159	.032
X-70 — Steel	.119	.177	.095
X-71 — Iron	.115	.169	.063
X-72 — Steel	.075	.156	.045

The average depth of pitting was thus .130 of an inch for the iron and .118 for the steel in the most corroded samples. Not only were a number of the samples practically destroyed in this case, but in two of the other investigations, notably the New York bath houses, and Allegheny Hospital, the test was really continued to destruction.

Since some of the factors governing corrosion have recently become better understood and heeded by manufacturing pipe steel with due regard to its durability, a reasonable conclusion to draw from the results of the five investigations is that pipe steel today is superior in durability, for it was equal to wrought iron in a period averaging from 8 to 12 years ago.

THE BALTIMORE & Ohio Employes' Magazine, which has recently made its first appearance, is one of the most attractive and readable employes' magazine which has come to our attention. It is somewhat larger in size than the popular magazine, being 9x12 inches in size and is printed on a yellow-tinted paper, giving it a pleasing appearance. Its subject matter is such as to be of interest to every member of the railway man's family.

* * *

A CERTAIN railway line had the reputation of being very badly laid, and the following incident is related in connection with it. They were rushing along at the rate of seven miles an hour, and the train was rocking atrociously. Passengers were rolling from one side of the carriage to the other or holding on like grim death to the window straps. Presently the motion became a little steadier. A traveler smiled faintly at the quiet-looking man opposite him, and remarked: "We seem to be going smoother." "Yes," said the quiet man, "we're off the rails now!"

* * *

THE POWER PLANT at the Milwaukee shop of the C., M. & St. P. has been equipped with stokers and ash handling machinery, the latter being installed by the Link-Belt Co., while the stoker is the Attica manufactured by the Westinghouse Machine Co. It was necessary to do considerable preliminary work such as constructing a sub-basement and placing the whole building on a pile foundation. The city of Milwaukee is making efforts towards smoke prevention and one of the reasons for the installation of the stokers is to comply more closely to the city ordinances.

CAR INSPECTION.*

By Lewis C. Ord, Gen. Car Insp., Canadian Pacific Railway.

Car interchange is without doubt the special feature in which the American railroads excel. All over the North American continent the vast network of railroads operates as a single system, over which cars move on various lines to their destination with little trouble or delay. This has been made possible by the action of the Master Car Builders' Association in early adopting standards of construction, inspection and maintenance. These standards today are closely followed in the construction of cars, and for the inspection of cars in service on their own lines as well as for cars in interchange or for foreign equipment. In outlining these rules, which are familiar to all car men, I will try to make plain the objects and methods to any others who may not have followed them closely.

To make it possible to interchange cars it is essential that the gauge of the track and the general dimensions and capacities of the cars be kept within certain limits. The gauge for the wheels is absolute and is alike on all standard gauge lines. The dimensions of the cars are kept within certain fixed limits, but the loads on flat and open cars are limited by the clearance dimensions of the various lines over which they pass. The gauging of these cars for clearance dimensions when necessary is one of the important duties of a car inspector.

The couplers all conform to certain dimensions, height, contour, etc., as is necessary. The air brakes operate interchangeably without difficulty. Wheel contour, axle and journal dimensions, brasses, wedges, etc., are maintained standard on most equipment, also most other parts likely to require renewal in ordinary service. In other non-essential features the design and material in the cars varies according to the standards of the various lines.

In this connection it should be stated that the M. C. B. rules specifically state that the standards of the Association shall not be binding upon the members nor the roads they represent. Any line may build cars which do not conform to the standards of the Association in a number of respects. But the success of car interchange at the present time is largely due to the way the members of the Association in charge of car construction and maintenance have been ready to drop their standards, often to adopt a design they considered inferior to the one they were using (perhaps at considerable expense), and to adopt the M. C. B. standards. It is due to this widespread adoption and maintenance of these standards that successful car interchange and maintenance is possible.

In the changes or standards adopted by the Association great care is used. A standing committee composed of prominent men selected for their familiarity with the subjects to be considered, investigate for the Association the varoius subjects and submit their recommendations to the Association. In the meeting they are discussed by the members and if approved they are referred to letter ballot to prevent an unfair decision and to give more time for consideration. The voting is as follows: One vote is allotted to each active member of the Association; each representative member who is directly in charge of the car work is entitled to one additional vote for every 1,000 cars owned by the company he represents. In view of the costs of many changes this is a very fair arrangement.

In adopting standards the approved arrangement or construction is generally adopted as "Recommended Practice" for some time, or until the various lines have had time to get ready for the standard or until circumstances make it advisable to adopt it as "Standard Practice." Some idea of the arrangement used in arriving at the taper of the brake mast, the contour of the present M. C. B. wheel, etc., was to plot out each design, take the average of them all and work in the nearest approach

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*A paper read before the Canadian Railway Club.

to the average that the construction would permit. In other cases entirely new designs have been adopted. Often several years' consideration have been given one detail by a committee, when they were not entirely satisfied with a design, before making a recommendation to the Association.

The M. C. B. standard lettering may not seem as well proportioned or located as it might be. The lettering at the ends is very high; this is to enable trainmen to locate car numbers on a moving train with the light of their lantern from on top without climbing down. The letters on the side may seem small and low. There is nothing much lost if they cannot be read half a mile away, but if they are large and high the conductor has to read them in sections and with difficulty. The seal hook seems low on a loading platform, but it enables a conductor to examine seals and take numbers without a ladder.

Similarly with the rules for loading material and the interchange rules. Men who have spent years on the subject consider the suggestions worked up by the various railroads and clubs and make their recommendations. An open session is held at Atlantic City, where the Arbitration Committee explain its reasons and hears arguments both ways before the recommendations are passed on to the Association for approval. The Arbitration Committee is the last court of appeal in arbitration cases. Its decisions with the arguments of both parties are published regularly and sent to all the other railroads for their guidance. These decisions are taken to establish a precedent as in ordinary law, and are regularly used to more strictly define any doubtful rule.

In general the rules make the owners of a car chargeable with all repairs made to it, except those necessitated by unfair usage, derailment or accident, or repairs wrongly made. Also, each railway company must give to foreign cars while on its line the same care as to oiling, packing, inspection and adjusting brakes as it gives its own cars.

Loaded cars offered in interchange *must be accepted* unless they constitute a violation of the law or will not pass the clearance limits of the roads over which the shipment is destined. This means if a car is not fit to run in the opinion of the receiving line they must accept the car and may either repair it and send it forward or transfer the load to another car, charge the cost of transferring the load to the road from which the car was received, and return the car when empty for repairs.

Empty cars may be refused by the receiving line if they are considered not safe to run. The M. C. B. Association has always considered each line the best and only judge of the fitness of a car to run and the decision of the inspectors of the receiving line is final and without appeal. This power was wrongly applied and some inspectors became so critical that serious hold-ups of loaded cars was occasioned and the rule which until 1910 allowed an inspector to refuse any car now allows them to refuse only empty cars.

The object of the M. C. B. rules throughout has been to make it possible for a line to repair foreign cars without expense to itself, and to penalize them for failure to make necessary repairs to make cars safe to run. Therefore, if any loaded car is delivered to a connection in an unsafe condition they are billed with the cost of the transfer and in addition have the bad order car returned to them empty for repairs which if made on their own line in the first place would cost them nothing more than the track room on their repair tracks.

This is certainly the most important rule in car interchange. It is as necessary that it be fully understood by the traffic department as by the car department. Trouble is apt to result on the road if, because foreign cars are received loaded in bad order and he cannot get them transhipped without serious delays, the car inspector lets them go forward. There is no other way of stopping the bad order cars. If on the other hand prompt arrangements can be made for transhipment the company is saved trouble with the cars on the line, is saved the necessity of making repairs on the cars, and the transhipment costs them nothing. The delivering company is sure to take action as it has to pay the costs of transhipping and has the bad order cars returned to it empty for repairs. Since the new rule, that loaded cars must be accepted, went into effect, there has been a tendency to let cars go forward which really should be transhipped, particularly in the case of light wooden cars with draft rigging or sills in bad order on districts where they are likely to be handled in long trains or with steel cars.

Loaded cars may be refused because of defects which are violations of the law, or inability to pass clearance dimensions. In detail, they are as follows:

(*a*) Cars having defects in violation of the Safety Appliance Act.

(*b*) Leaking tank cars containing inflammable liquid must be repaired or transferred without any unnecessary movement, or at nearest available point with least possible risk.

Cars loaded with explosives shall be handled in accordance with the regulations of the Interstate Commerce Commission.

(*c*) Cars improperly loaded, when not complying wtih the rules for loading material.

(*d*) Loading of open cars when dimensions of landing are in excess of published clearances of roads over which the shipment is destined.

(*e*) When cars cannot pass approved third rail clearances of American Railway Association.

When a car is received in interchange, if the car has any defects for which the delivering company is responsible, the receiving line shall require that a defect card be securely attached to the car, usually to the outside face of intermediate sill between cross tie timbers on wooden cars, and on steel cars to cardboard located either on cross tie under car or inside side sill at end of car. A defect card is simply a list of the defects for which the company issuing it is responsible, and is the necessary authority to bill that company for the necessary repairs when made.

In interchange the defects for which the delivering company is responsible are principally for missing material, damage to cars through derailment, unfair usage or accident, or for wrong repairs made by them. Skidded wheels, chipped or broken flanges (unless caused by seams), and cut journals are considered caused by unfair usage and are chargeable to the delivering company.

In making any repairs to a foreign car, whether the repairs are chargeable to the owners, are covered by a defect card (or authority to charge some other company with the repairs), or are made by the company at its own expense, a repair card covering the details of all the work done must be applied to the car. This card is in triplicate, one being filled in on both sides giving car number, name of road making repairs, date, station, inspector's signature, and particulars of all material and labor, and securely attached to the car. It is located in a protected place and is written on both sides so that the information can be read without removing the card, but insuring on the other hand that the inner face shall always be legible. One copy of the card (record repair card) is held at the station where the work was done. The other copy (billing repair card) is sent with the bill for doing the work, or in case no bill is rendered, is sent to the car owners with the words "No Bill" written across the face. This is done so that in the case of repairs wrongly made the owners of the cars may bill against the company, making them with what it costs them to make the repairs properly.

Unfair usage is a very hard thing to legislate upon, yet the

M. C. B. Association has a set of rules which are strictly fair in most cases. If there are exceptions they act both ways, and therefore are fair to those interested. As before outlined, the ordinary repairs to a car are chargeable to the car owners—sills, wheels, couplers, draft gear, posts, braces, siding, lining, roofing, etc. Skidded wheels, cut journals, etc., are unquestionably unfair usage. But it becomes difficult to say how many sills could be broken at one time under fair usage. Assuming, therefore, that companies will refuse or repair foreign cars with decayed or defective sills and that cars in service should be in good order, it is considered that if it is necessary to repair the following parts of a car at the same time that the car has received unfair treatment.

Damaged coupler body accompaneid by damage to draft timber or its substitute, and end sill.

Damaged coupler pocket accompanied by damage to draft timber or its substitute and end sill.

Damaged end sill accompanied by damage to draft timber or its substitute or longitudinal sill, and damage to either coupler body or pocket.

Damaged end sill accompanied by damage to two longitudinal sills.

Damaged longitudinal sills if necessitating replacement or splicing of more than two sills.

Damaged corner and end posts if necessitating the renewal of more than three posts.

Missing coupler and attachments will be considered as damaged, unless shown to the contrary.

The list given is important. If cars are received on the line with sills and draft rigging in bad order it is not unlikely to result in two split center sills and a damaged end sill even in ordinary service. Under such conditions the company moving the car is compelled to pay for the cost of making temporary repairs to bring the car in, the delay to trains, the cost of transhipment, and the delay to freight as well as the cost of making the repairs. If proper material is not to hand and temporary or improper repairs have to be made, they will be billed in addition with the cost of making the repairs properly when the car gets home. All this expense could have been avoided by transhipping the car at the interchange point at the expense of the delivering company.

On the other hand, while fortunately such cases are not common, usually when a car is damaged to the extent given above it has received unfair usage and the company in whose possession the car is, is properly penalized by having to make the repairs at their own expense. If it is recognized that the company is responsible and is penalized, should it not be possible to penalize the man responsible? We may be getting beyond the possibility of disciplining for broken or pulled out couplers, but in the more serious cases of unfair usage should it not be possible to take some action?

Occasionally car foremen will wire to obtain authority to repair cars which are damaged badly enough to constitute unfair usage, but which they consider due to decay. Occasionally in such cases when they are old cars this authority will be given and authority given to repair cars at the owner's expense. Except in the case of refrigerator cars, such a request is seldom justifiable. If the car was in bad order it should have been returned at the interchange point, or the necessary repairs made. But if the road neglects to do either it is only right to penalize the failure to make the necessary repairs in time. Many lines, when their old wooden cars are considerably damaged, prefer to have the cars torn down rather than have the repairs made. If repairs are started on a foreign car without authority, frequently the owners wish the car destroyed or sent home, and considerable trouble results.

Throughout the M. C. B. rules the idea to penalize the road failing to make necessary repairs, and to provide that repairs to foreign cars be made at the owner's expense is very apparent. It is evident that if cars were maintained in proper repair, interchange inspection would be very easy and little delay will result. At some of the larger terminals some short switching lines do not feel that they should be called on to make repairs, as their mileage is short. As a result the connecting lines object to receiving the damaged cars in interchange, and much transhipping and trouble results. These switching companies, instead of providing themselves with adequate facilities for repairs, which in such cases would be borne almost entirely by the various car owners, they have resorted to special agreements to prevent delays to cars in interchange. The subsequent bad condition of the equipment has resulted in most of the large terminals reverting to M. C. B. rules. But although they have gone to M. C. B. rules they have not altogether got the idea that was so strongly brought out at the last meeting of the Arbitration Committee, at open session at Atlantic City—that if railroads gave foreign cars proper attention as well as to their own equipment, no more delay should result in interchange than at any other regular inspection point.

On furthering this idea a circular has been sent out trying to free the delivering company from any responsibility for failing to have made necessary repairs which, though chargeable to the car owners, becomes chargeable to the delivering company if the car is offered in interchange with the repairs not made. It is evident if this penalty for failure to make necessary repairs be removed that less repairs will be made. It was the opinion of the M. C. B. Association as a whole that the great necessity at present was that, with heavier power, longer trains and denser traffic, car failure in service should be reduced. With the same meaning they resolved that they would bring to their respective superior officers the pressing need for better car maintenance. In view of this it is to be hoped that the clause of the circular removing the responsibility and penalty for failure to make necessary repairs will not be approved by letter ballot.*

On the other hand prices of labor and material have been advancing and it is proposed to make a 10% advance in M. C. B. prices which will more nearly make the M. C. B. allowances cover the actual costs of the work. The net prices probably cover, but when the overhead charges are added in it often costs more to do the work than the amounts which can be charged. The proposed increase should more nearly even up the charge and the actual cost.

Before discussing some of the details of inspection I would point out that the interchange inspectors have to be familiar with the 125 or more rules of the M. C. B. Association regarding interchange, the rules for loading material, the instructions for handling explosives, the safety appliance acts, the clearances of the various connecting lines, the third rail clearances of the American Railway Association, in addition to the necessary attention to heated or refrigerated shipments, the inspection of empty refrigerator cars for heaters, etc. Besides these there are the various standard instructions issued by each line to its inspectors which require to be observed.

The cars of any railway, on its own lines, are more closely checked up than foreign cars, except where safety is concerned. The repairs to its own cars are usually in excess of M. C. B. requirements in interchange, and special instructions usually cover the making of at least the heavier repairs.

Repairs may be made to any foreign car having defects which render it unsafe to run, unsafe to trainmen or to any lading suitable to the car.

Repairs to foreign cars must be promptly made and the work must conform in detail to the original construction and with the quality of material originally used, except that M. C. B.

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*This proposition, as well as the 10 per cent advance in M. C. B. prices, has been carried since this paper was written.—Editor.

Standards may be used in place of the parts forming the original construction when of suitable dimensions not to impair the strength of cars. This is of considerable importance in lessening the repair stock to be carried.

Various limits are given for the various parts of a car which would justify renewal. In this connection several points are worthy of detailed consideration, particularly with regard to wheels and axles.

The freight rules provide that a cast iron, steel or steel tired wheel may be removed when the flat spot is 2½ in. or over in length. The passenger rules make the limit for a flat spot 1 in. in length, for either kind of wheel. A very little consideration will show that this rule cannot always meet the situation. If the limit of 1 in. is safe for passenger trains the limit of 2½ in. is too high for freight cars, which under service conditions attain speeds very nearly as high as passenger trains, but with wheel loads very considerably in excess of the normal passenger wheel load. With the cast iron wheel there is danger to the wheel in running with a big skid, while in a steel or steel tired wheel there is more danger of breaking rails than of danger to the wheel. But with a cast iron wheel if the skid wears out there is less liability of trouble than with the steel tired wheel. The wheel sliding is much more severe in the winter months and occurs oftenest under cars with heaviest wheel loads, particularly on cars with four wheel trucks. The same is true of shelled spots on steel tired wheels. They are commonest under cars with the heaviest wheel loads, and require to be watched for carefully, particularly in severe winter weather.

These shelled spots develop rapidly and are apt to cause serious blows to the rail. For this reason at originating terminals on long run trains it has been considered advisable to take out any wheel which shows even an appearance of a shell (it is also an economy by reducing the service metal lost in turning), and insures the car going through to its destination without being held up for wheels at some intermediate station. In winter weather the detection of these skids, particularly in passenger service, is very important, but if the skid or shell is large it is likely the box cover will be missing or the journal box, brass or wedge may be broken. When trains are arriving and leaving inspectors always listen for a pound, which would indicate a flat or shelled spot, or other wheel defect. These indications are very helpful in assisting inspectors at intermediate stations in detecting defective tires, which otherwise might not be noticed.

On heavy capacity freight cars in winter weather a car inspector would be justified in removing a skid less than 2½ in. in length, while on a light car in summer weather a skid of that length would not be serious.

Broken wheels may well be considered. Frequently after a derailment a broken cast iron wheel is found, and under such conditions it is usually assumed to have been the cause of the derailment. When a wheel is found with one piece only gone, with the edges all sharp and unbroken, the missing piece broken out in one piece, it is seldom that such a wheel caused a derailment, in fact it may safely be assumed to have been the result of the derailment. On the other hand, if two or more pieces have been broken out at different times or if the edges of the break are broken or pounded it is safe to assume that the wheel broke before leaving the rails and was the cause of the derailment. If the flange is broken and the break is in a line at right angles to the center line of the axle or nearly so, it is safe to assume the flange stripped from overheating.

This latter defect I believe to be the most serious defect which occurs on cast iron wheels. In descending grades of one per cent or even greater, it has been my experience that usually only a portion of the retaining valves were turned up, except on unusually long grades or where stops had to be made before the foot of the grade was reached. I have myself and I have seen others, bring trains down comparatively long and heavy grades with from five to fifteen retaining valves only turned up on trains of up to forty cars in length, and proportionately for longer trains. In winter weather the amount of brake shoe pressure required to bring a train down a grade at a high speed is considerable. If the heat produced is spread over all the wheels in the train none of them are likely to be overheated under ordinary conditions; but if limited to a few, the wheels are subjected to the worst strains they ever get in service. Such braking would cause a steel tire to expand and loosen on its center. The tread of the cast iron wheel when overheated will also expand. The flange is very deep and stiff and is not being heated by the brake shoe, the heated tread shoves up, the flange resists and the two crack along the throat of the flange. Usually these cracks show purple in color, showing how intense the heat has been. A dragging brake may also have the same effect. It is true that good wheels will stand a great deal of such treatment, but there are the wheels which are not so good to be considered. If given fair treatment they will usually last very well, but are liable to fail from severe overheating, nor ordinary or even severe service braking, but heating which would result in a very loose tire on a steel tired wheel.

The seamy wheels are always the most dangerous and should be removed whenever the seams are near the throat of the flange, or if any considerable length in the tread of the wheel. Cracked plate or cracked bracket are defects usually due to overheating; the seams in the throat of the flange, although generally an original defect, are usually imperceptible at first, but are developed through overheating. Any wheel which has been hot enough to scale off the oil and grease or to show discoloration should be carefully inspected for these defects.

Worn flanges require considerable comment. They are caused principally by the wheels being of unequal diameters, although somewhat to trucks out of square. It is noticeable that on the care, usually only one flange of a pair of wheels is worn, the worn flange being on the smaller wheel. Sharp flanges develop much more rapidly on passenger cars, probably due to the difficulty in turning wheels to within 1/32 in. of the same diameter (which is the extreme variation allowed for cast iron wheels), but even more to the heavier and more constant braking, the unequal abrasive effect of the inserts of brake shoes and variations in the relative hardness of the tires. In addition the flanges of the steel tired wheels are relatively softer and wear more rapidly.

Many claims are made for the saving made by roller side and center bearings in reducing flange wear. As the flat side or center bearings should give equal resistance to movement in either direction, flange wear should show equally on both wheels. Cases are very rare where both flanges are worn and usually are due to second hand wheels remounted. As a protection against derailment when the momentum of the car or the elevation of the track may have thrown considerable load on one or other side bearing of a car entering a curve, roller side bearings are very valuable and well worth adopting.

One other feature of worn flanges should be considered. When a wheel has flat vertical surfaces extending 1 in. or more from tread for light cars, or ⅞ in. for cars 80,000 lbs. capacity or over it is said to have a "sharp flange." This limit is really for the safety of the wheel, but also to prevent splitting switches, frogs, etc. But on a curve or tangent the worn or sharp flange is no more likely to mount the rail than a full flange, particuarly a newly turned flange on a steel tire or steel wheel. Again a flange 15/16 in. or less, gauged at a point ⅜ in. above the tread for cars under 80,000 lbs. capacity, or 1 in. thick or less for heavier cars, is a thin flange and should be removed for the safety of the wheel, but if it is not worn sharp will be liable to cause no other trouble than the failure of the flange itself. The matter has come up that a flange almost to gauge has been blamed for a derailment which otherwise could not be explained. At a frog or switch this might be possible, but not elsewhere. Also the worn flange should be uniformly and at all times be called a good wheel up to the time it reaches the condemning

limit, or else the limits changed to keep the wheel at all times safe.

One of the most serious defects a car may have is a missing cotter in a brake hanger pin. Cotters wear out with the rattle and motion of the gear and should be renewed. Old cotters used over often are apt to break and should be renewed. While certainly the smallest item of a car in size they are one of the most important things to maintain and are frequently overlooked or their importance underestimated. A check over the split cotters ordered at the various stations will give a good idea how closely this item is followed up. Of equal importance is the maintenance and proper application of nut locks, particularly on all bolts in the trucks.

Draft rigging maintenance is unquestionably serious, probably at the present time the most serious item of freight car maintenance. Since the time our older wooden cars were built the tractive power of the locomotives has increased from 15,000 lbs. to 35,000 and 40,000 lbs. for locomotives in regular through freight service and to very much higher capacities for various special service. The strength of the draft rigging which was suitable for the lighter locomotives has been steadily growing less, due to service conditions, and it is not surprising that the draft rigging trouble with old wooden cars is serious. A number of the larger railroads are retiring their older cars whenever they require extensive repairs, and are applying steel center sills and draft rigging to the more modern cars as they require sill renewals. For the next few years the draft rigging trouble with the wooden cars will steadily increase and to prevent delays and detention in service much more critical inspection of draft rigging will have to be made and the timbers maintained tight at all times.

Yet notwithstanding the long trains and heavy power the greatest damage to draft rigging is done in yards and by yard crews. As the congestion in a yard increases, the men, in an effort to hurry, take greater chances and the car and roadmen's troubles increase in direct proportion.

One other rule which some roads have entirely given up trying to enforce is pulling hose apart without uncoupling them. The hose that is torn off or fails is the least serious item, but the strained hose which leaks as a result is one of the costly items of car maintenance and delays and trouble in service.

You will notice I have not consistently followed the subject, but have enlarged on some points and have passed over others with little consideration. In going over a subject so generally well known I have kept rather to points of special interest than to a faithful outline of car inspection, as the subject is much too large to consider in full. I would ask any others who have any points of special interest to add their observations to my own. To any of those to whom I have not made myself sufficiently clear, I will be glad to further explain. Passenger inspection for want of space I have almost entirely ignored, except some special features of wheel inspection.

It has been my object to give you an idea of a few of the car inspector's duties, of the importance of some of them, and to explain some features perhaps not generally understood. At this time it is urgent to point out the draft rigging troubles with the old wooden cars, which is bound to increase in proportion to the increase in the heavier locomotives. Car interchange is growing heavier, and to prevent troubles with bad order foreign cars in transit it is necessary to provide for prompt transhipment to enable the cars to be returned, and to provide that all cars when loaded be in good order to enable them to be moved through to their destinations without delays.

Most car failures are preventable in fair service. At one large station, after the inspectors had been checked up and closer inspection insisted upon, it was reported that the road car had not been ordered out for a month. That was one expected result; the detentions were less. But the number of cars marked off for repairs each day was greater and they had to be taken care of as additional work. That was the other expected result. The average inspector is competent and will give as close inspection as desired. But with the repair tracks full and bad order cars around the yard, he will hesitate to make a bad situation worse unless the condition of the car makes it necessary.

The money spent on the repairs of foreign cars is little loss. The work done is paid for by the owners and delays in service prevented. But the most essential feature of all is the proper repair of all empty cars when on their own repair tracks. All the parts of the car requiring it should have the necessary repairs or renewals made and the car put in shape to go into service and stay, and not to be back a few days later for some small defect, which because it was not very bad nor very serious was not attended to earlier. The old saying: "A stitch in time saves nine," is nowhere more true than in car repairs.

ENGLISH TRAIN LIGHTING EQUIPMENT.

The accompanying illustration Fig. 1 and drawings Figs. 2 and 3, show the automatic dynamo, governors and switching apparatus of a novel English electric train lighting equipment developed at Silvertown. It will be seen that the equipment consists of a dynamo driven from the coach axle, and carrying on its shaft a governor which is used to operate the controlling apparatus. There is a double battery of accumulators provided, one of which is normally connected to the terminals of the lamp circuit, while the other is connected to the armature terminals so that it may receive a charge.

The electric generator is of usual construction except that the field magnets are differentially wound, one winding being a shunt winding connected by the switch gear to the terminals of the battery which at any given time is connected to the lamps (hereafter called the discharge battery), whilst the other is a series winding through which is passed the whole or a part of the current supplied by the dynamo to the second battery, called the charge battery. This winding is connected up by the switchgear so that it opposes the shunt winding, and tends to demagnetize the magnets and weaken the field in which the armature is rotating.

It may be stated that, connected as a shunt series to the series winding, there is a resistance or diverter, which can be adjusted by hand to regulate the proportion of the charging current passing through the series winding; so that if the conditions of working are such that there is an increase in the ampere hours or discharge from the batteries, the rate of charge of the charge battery can be increased, or if there is a decrease, the rate can be decreased.

By so adjusting the diverter resistance that, with any predetermined value of the charging current, the proportion of this current passing through the series coils gives a demagnetizing effect equal to the magnetizing effect of the shunt coils, it is possible to limit the charging current to something less than this predetermined value, there would be no magnetizing force and the dynamo could not generate an electromotive force and consequently could not supply any current to the battery. At the same time, as none of the current passing to the lamp circuit passes through the series coils, their demagnetizing effect is not dependent on the

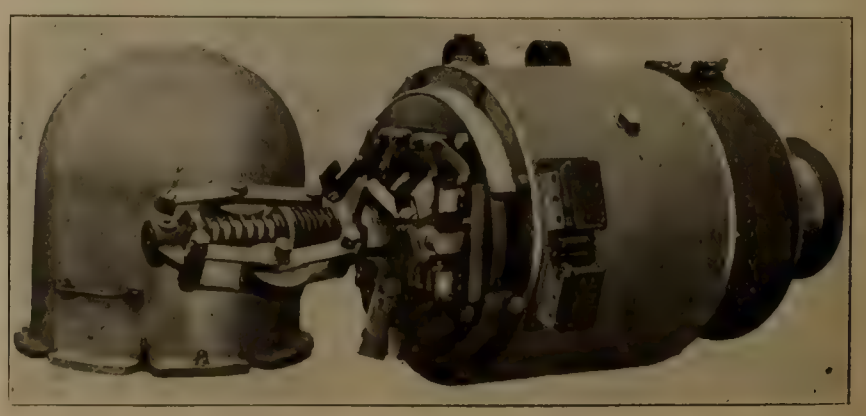
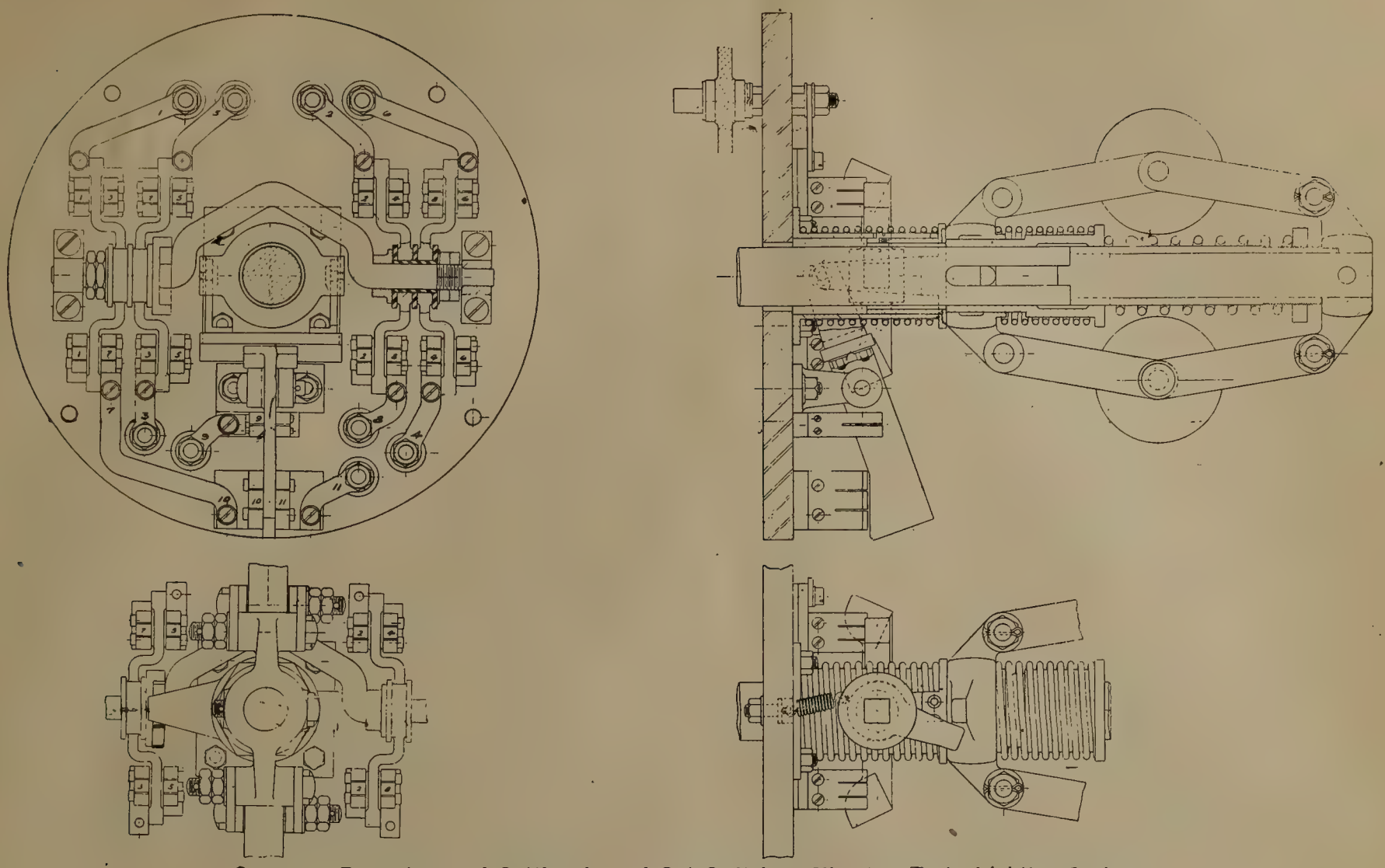


Fig. 1—Generator.



Governor, Reversing, and Cutting In and Out Switches, Silverton Train Lighting System.

number of lamps in circuit, and whether the full number, half or no lights are on, it is still impossible for the charging current to reach the predetermined value.

The armature shaft of the dynamo carries a centrifugal governor, so arranged that it operates a "cut-in" switch when the speed of the armature is such that the dynamo, if excited by the shunt coils only, would give a voltage equal to the normal lamp voltage. This cut-in switch first connects the shunt circuit to the discharge battery so as to excite the magnets of the dynamo, and then connects the armature of the dynamo to the charge battery through the demagnetizing series coils and its diverter, and to the discharge battery and lamp circuit through the lamp resistances.

The governor also carries on its collar a projection which, as soon as the armature begins to rotate, engages with a rocking lever which in turn operates a reversing switch, provided there has been a change in the direction of the rotation of the armature. This collar works against a light spring for the first half inch of its movement, so that it is quickly drawn away by the governor when making only a few revolutions per minute, sufficient for the projection to be clear of the rocking lever and thus prevent the repeated striking of the former against the latter.

The reversing switch not only changes the connections between the armature and the batteries so that the dynamo gives current in the proper direction, but also changes the batteries over so that the one that was the discharge battery becomes the charge battery and vice versa. In addition to the above apparatus, a lamp switch is provided, so that all the lights, or half lights, can be switched on, and which also couples the two batteries in parallel for charging when all lights are switched off.

The accompanying drawings, Figs. 2 and 3, show the general arrangement of the dynamo and the construction of the governor and switchgear. The numbers on the switchboard where a circle is shown denotes the points at which the connections pass through the switchboard, the other numbers refer to the reversing and cutting in and out switches 9, 10 and 11 are the cutting in and out switches and 1, 3, 7, 5 and 2, 4, 8, 6 upper contacts and 1, 7, 3, 5 and 2, 8, 4, 6 lower contacts on reversing switch.

If it is assumed that the train is just starting and all the lamps are swtiched on, the direction being such that the reversing switch is in position shown by the full lines (upper contacts), the current will flow through the various circuits in the following manner—from No. 1 battery to upper contacts 6 and 8 to lamp switch and back to No. 1 battery. A part of the current will be supplied by No. 2 battery through contacts 2 and 4 through the series winding and its diverter, than through the lamp resistances to the lamps back of No. 2 battery.

As soon as the speed has been increased sufficiently the shunt winding will be connected to No. 1 battery to excite the shunt through contacts 6 and 8 to shunt coils and contacts 9 and 11 back to No. 1 battery, thus ensuring the voltage being built up before the armature is connected with the batteries and lamps.

It is clear that an increased speed will now connect 9 and 11 to 10 and the armature will supply current to the load in the following manner: The current passes from the armature to contacts 1 and 3, after which it divides, part going through the lamp resistances to the lamps and part through the series winding and its diverter and contacts 4 and 2 to No. 2 battery (which is the charge battery when running in this direction). The current from No. 2 battery will now join that from the lamps and pass through contacts 11, 10, 7 and 5 back to the armature.

In case only half lamps are required, the current will flow as before except that there will be no circuit through one group of lamps, nor through one of the lamp resistances which were in parallel for full lights. In the event of no lights being used, the two batteries are placed in parallel by the act of switching the lights off. In this case, the

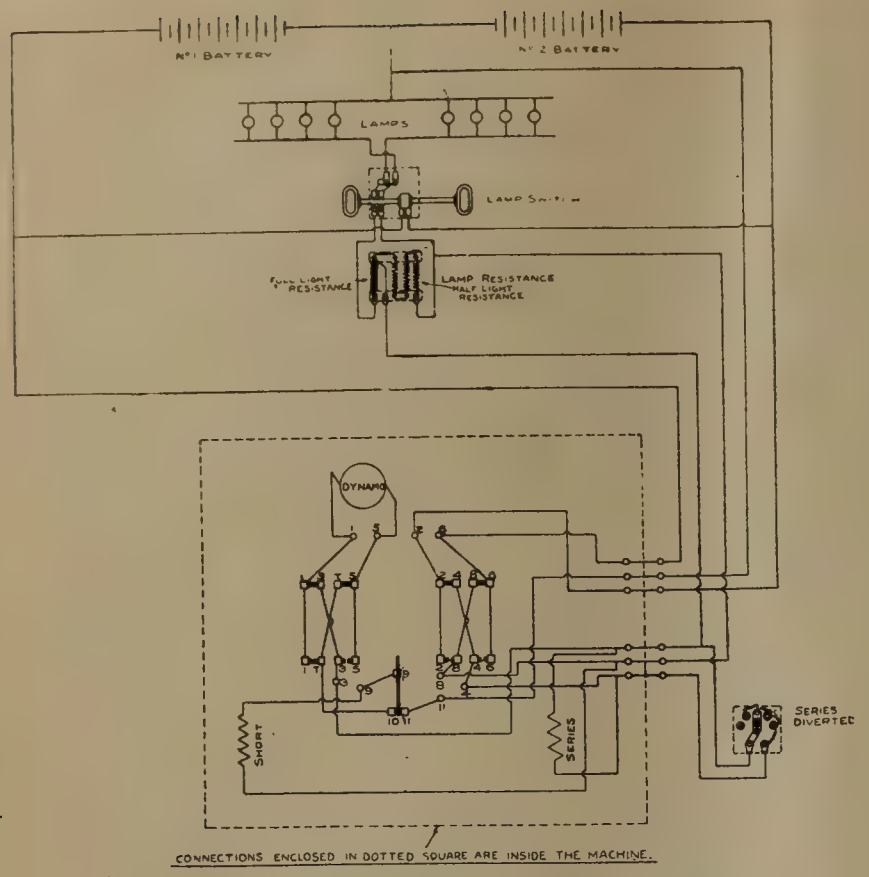


Diagram of Silverton Train Lighting System.

current will flow in the following manner: From the armature to contacts 1 and 3, after which it divides, part going to the series winding and its diverter and part to the "half light" lamp resistance.

After passing through the series winding diverter and lamp resistance in parallel the current again divides, passing through both batteries and the shunt winding in parallel and through contacts 11, 9 and 10 to 7 and 5 to the armature.

It is claimed that the advantage gained by this system of regulation is that it is practically impossible to charge the battery at an excessive rate, and in providing an easy means of adjusting the amount of charge to the requirements of the battery is very considerable, and the cost of maintenance of the battery should be appreciably reduced as it will not be necessary to wash it out or to replace the plates frequently.

TERMINAL TESTS IN AIR BRAKE PRACTICE.

By H. J Minnick.

Among a great many the impression seems to prevail that terminal tests are made only to determine the approximate braking power of trains and to know that sufficient brake effort is available to insure trains being handled successfully on descending the grades of the respective divisions.

Under favorable conditions trains of one hundred cars are being handled successfully, while accidents and serious delays often result in handling trains of thirty cars when the preparation or inspection has been neglected and much more depends on conditions than on the operation of the brake valve, because "The operation of the brake is according to fixed laws and conditions over which the engineer of all men has the least control."

When handling modern equipment cars are sometimes in first-class condition, including all air brake appliances, and still the train cannot be handled successfully.

Some time ago a train consisting of twelve modern passenger cars left its initial station and the clearance cards issued showed all the cars in good order.

The train was broken in two twice on the first district, passed over the second successfully, and was again broken in two on the third. In addition to the tests by the inspectors, the crews made tests after each accident. The brakes were applied and released in the usual manner and worked satisfactorily. The crews who handled this train were the oldest in service on the system and the cause ordinarily could not be charged to rough handling or poor manipulation.

As a result of these accidents the traveling public and the mail were delayed until the lost time was made up, and most of the first-class opposing trains were delayed at meeting points, and in turn the movement of a great many second and third class trains was affected.

When the fourth terminal test was made by the inspectors the rear three cars were discovered operating as the LN schedule, while the remainder were operating as the former standard. All who handled this train over the districts mentioned, or who were in any way responsible for the inspection, were severely censured, as it all was the result of improper terminal tests.

Another illustration of conditions over which the engineer has very little control is when handling the "empty and load" brake equipped cars.

The design of the brake is such that, when operating as an empty brake, a full service application from seventy-pound brake pressure will cause the cars, if empty, to brake at 60 per cent, and when loaded to full capacity they will brake at 40 per cent if operated as a load brake, but if allowed to operate as a load brake when empty they will brake at about 180 per cent, and under such conditions slid flat wheels often will result.

The rules require the brakemen of freight trains to assist in making terminal tests, commencing invariably at the rear, and to have the train in readiness to make a test as soon as the engine arrives, and, since it no longer is necessary for brakemen to assist conductors while taking seals on loads and in the near future the Gross red seal will be placed on every empty car, the inspectors soon may have more assistance while making tests.

The rules require inspectors to repair train-line and other leakage and, when the pressure is obtained, to "request the enginemen to apply the brakes," then make a car to car inspection while they are applied and after they have been released, repairing existing defects where time and facilities will permit.

We often see long trains inspected quickly and with apparently very little attention given to piston travel. This often aggravates conditions, as under favorable conditions a ten-pound brake pipe reduction will cause the cars with five-inch piston travel to brake at 49 per cent, while those with ten-inch brake will brake only at 19 per cent, and with few exceptions the cars with ten-inch standing travel have no brake effort at all when running.

It is not uncommon to see inspectors bleeding off cars that fail to release, and this often is responsible for slid flat or cracked wheels and sometimes for derailments, for, if the brakes cannot be released from the engine at a terminal, ordinarily they cannot be released at any other point.

When we take into consideration the fact that the brake on a modern car is more powerful than is the locomotive, should we be surprised at the great loss and damage resulting from trying to start cars on the rear of long trains that fail to release?

During the transition period it has been recommended and made essential that inspectors note the number and location of K valves and notify the enginemen, but still this has been entirely overlooked a great many times.

By the time inspectors reach certain cars they often have leaked off, failed to apply or have released. We regret to state that in many such cases the inspectors merely find out if the auxiliaries are partially charged and if so to count them in good order. This practice often is responsible for undesired quick action and other bad results.

Assuming the estimated cost as being correct, the party who is responsible for pulling out one drawbar in thirty days increases the cost of his services one hundred dollars, from which the company receives no returns, and still his salary remains the same.

There is no provision made for making terminal tests until the pressure can be maintained, or for leaving or handling trains between terminals with leakage to exceed five pounds per minute, excepting by special instructions from the trainmaster or his superiors.

The excuse generally offered for failing to make tests as outlined in instructions has been, "Time is not allowed." The general superintendent of one of our large roads has made this point clear in a letter as follows: "There is not much dependence put in the statement that 'Time is not allowed.' These conditions are placed in the hands of those responsible at various points, and, while it always has been a question as to how much time should be consumed, no specified time ever has been set. Signals are provided that will hold trains, and no one is authorized to remove them, and if any specific evidence of any particular case or cases can be shown, where time has not been taken or allowed, I will take it up with those responsible and see that obedience is paid."

We often see the irregularities mentioned, and all will agree that many of them easily can be overcome.

During a thirty-day period recently passed, over one thousand trains were handled on the Pan Handle Division, none of which was broken in two, and there were only two slid flat wheels, which proves conclusively that the equipment, its inspection, maintenance and operation on the Santa Fe is seldom if ever equaled and never excelled.—*Santa Fe Employes' Magazine.*

ECONOMICAL RAILWAY CRANE.

The advantages and economies obtained by the use of electric motors as compared with steam engines for operating railway cranes are daily becoming better known. Many orders for electric cranes have resulted, especially for the manufacturers, that have from the first used the most reliable of material and parts.

An electric crane is always ready for duty, an essential of any serviceable crane; there is no time wasted in getting up steam, which is often a serious handicap for steam cranes. Another advantage of the electric crane is that power is consumed only when actually being used.

The illustration shows a typical high grade electric crane owned and used by the Illinois Traction Co., and used for wrecking purposes on its Danville and Urbana division. This crane, which was furnished by the Browning Engineering Company, is equipped with a 30-foot goose-neck boom, with a main and an auxiliary hoist. The main hoist has a radius of 25 feet, and the auxiliary hoist a radius of 30 feet. The maximum lifting capacity of the main hoist is 30 tons at 12 feet radius, and 11½ tons at 25 feet radius.

The hook speed of the auxiliary hoist is 200 feet per minute while that of the main hoist is 50 feet. The working weight of this crane is 65 tons. Its height is 13½ feet; width, 9 ft. 10 in., and length 24 feet. The distance between truck centers measures 15 ft. 2 in. The wheels are 33 inches in diameter and are of the M. C. B. rolled steel type.

The motors are Westinghouse No. 303 railway type. Operating on direct current, the motors are equipped with commutating poles, so that there are no commutation troubles. The control is also Westinghouse, and designed so that the crane is handled by one man. Power is taken from wires overhead and lead to the controllers through a collector ring on the rotating base, and a shoe on the stationary base. All wiring is enclosed in metal and fibre conduit so as to be protected from moisture and mechanical injury. The crane is self-propelling at the rate of 600 feet per minute.

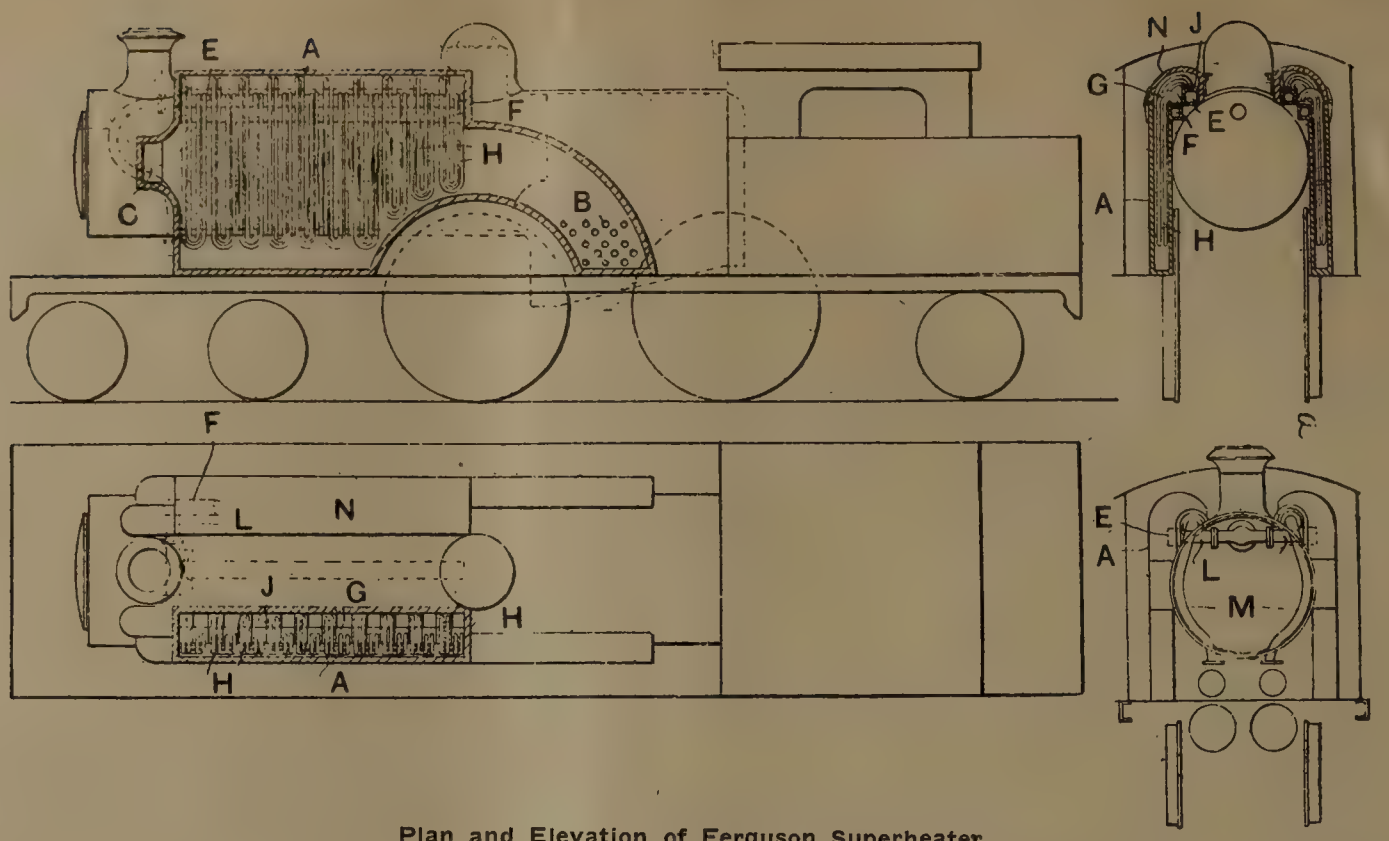
Economical Electrical Crane.

FERGUSON LOCOMOTIVE SUPERHEATER.

By Thomas Reece.

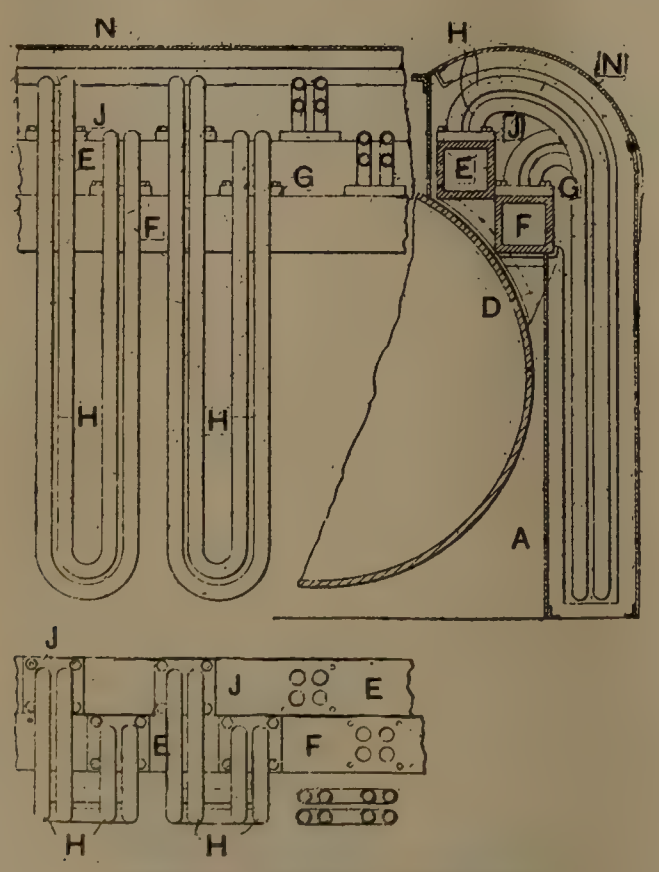
Superheater development moves rapidly ahead nowadays and a further step just patented in England is here described. It is known as the Ferguson superheater and is different from others in that the working of the superheater has been arranged outside the boiler instead of placing it in the flue tubes. With this arrangement should any tube give out the engine can be worked with saturated steam as the design includes a damper for shutting off the superheater. Also with other types having their tubes in the boiler, the superheater tubes have to pass along the flue tubes of the boiler, and are inaccessible.

The diagrams appended give clear details. In this arrangement the superheating tubes are in independent sections or groups, connected at their ends to removable cover plates closing over openings in the top of inlet and outlet steam headers. Two casings A are arranged on each side of the boiler, as shown. The furnace gases are admitted to the rear end of each casing through hollow tubular stays B, and pass off from the front end of the casing to the smoke box through the passage C. As shown, the bottom of the casing is made to rest on the top of the main horizontal longitudinal frame of the engine. The upper end of each casing is enlarged so that it extends inwards for a distance over the top of the cylindrical shell of the boiler. D is a bracket curved to conform to the exterior of this portion of the shell of the boiler and secured to it. The bracket is formed with two shelves, one at a higher level than the other and in rear of it so as not to overlap it. Upon each shelf is



Plan and Elevation of Ferguson Superheater.

placed a header; the header E on the upper shelf is clear of the header F on the lower shelf, so that the cover plates G which close over openings in the top of this latter header can be removed without being interfered with by the header E. The superheating pipes H are each connected at one end to one of the cover plates G, and at the opposite end to one of the cover plates J secured to the top of the header E. Each cover plate has four superheating pipes secured to it. As shown, the superheating pipes rise upwards from the cover plates J, are bent forwards and then downwards and made to extend nearly to the bottom of the casing, where they are bent back towards the



Header for Ferguson Superheater.

rear or towards the front end of the engine and then bent upwards and made to extend to the upper part of the casing, where they are bent over and secured to the cover plates G. Steam is supplied to the front end of the headers F through pipes L, and is led away from the front end of the headers E through pipes M to the cylinders of the engine. A hinged door N is provided closing over the top of each casing A.

FUTURE OF LOCOMOTIVE CONSTRUCTION.*

By Leopold Kljment.

When the gas engine was discovered and first used in practice, in the sixties of last century, many prophesied that the steam engine would soon disappear, and when electric light was introduced it was said that gas light was doomed. In exactly the same way it is now asserted that the electric locomotive is the superior of the steam locomotive and will replace it, and as in such statements important considerations are often disregarded, I propose to try to explain, in as simple and intelligible a way as possible, the relations between the two, and to show that just as the development of the mantle system of lighting has made it certain that gas lighting will continue to be used, so will the steam engine, without which our present state of civilization would have been impossible, retain its full importance, as it has up to the present. Similarly the steam locomotive, following the same general law, is capable of further development and will be used for a long time to come.

Only too frequently are comparisons made, either verbally or in writing, which are one-sided because important factors, such as water-power operation, possible wheel-pressures, etc., are left out of consideration. Or else a picture is shown of a steam locomotive with tender, side by side with an electric locomotive, in order to illustrate the comparatively small size of the latter, for equal power; but then the central power station essential to the latter is not sufficiently considered. In the case of motor cars and of the first electric locomotives constructed, stress was laid on the great advantages which certainly existed, that the electric motor could act either direct or only through spur gearing on the axles, while the steam locomotive had a system of power-consuming reciprocating rods, which, moreover, was a source of trouble when running 'round curves. These advantages, together with those of the ready divisability of trains and the possibility of running large numbers of them, have lately been left out of consideration in the design of electric locomotives, and the most recent locomotives of this kind not only have rods for coupling the wheels, but also a separate driving axle or shaft (the use of which on steam locomotives has long been given up), and in some cases cog-wheel transmissions as well. In the case of the electric locomotive,

*Bulletin of the International Railway Congress.

a driving shaft is necessary and has the advantage that it makes it possible to have the electric motors at a higher level, so that the vertical forces are taken up by the springs of the vehicle, without injurious effect, and converted into horizontal forces. Now, although I have said that this is an advantage, I must add, for the sake of completeness, that the driving shaft must be supported in comparatively strong bearings, as closer examination of the forces in action shows that forces have to be transmitted from the left side to the right and vice versa. But this introduces a power-consuming element, which leads to expense, and in this case again advantages are combined with disadvantages. In the case of the steam locomotives it would also be necessary to have a driving shaft, if instead of using a horizontal steam engine with the cylinders in the usual position, it were desired to use a vertical steam engine with the cylinders above. In the case of the steam locomotive, as in all other cases, the advantages must be compared with the disadvantages, and it is readily intelligible that it is impossible to give the preference, once and for all and with dogmatic certainty, to one or the other system. On the contrary, it is necessary to examine, in each individual case, whether the advantages or the disadvantages are of greater importance from the economic point of view, in order to make a proper choice possible. The important point is that both the steam locomotive and the electric locomotive, which we are now considering, are adhesion locomotives, and the wheels must be coupled by means of rods, if there are to be fewer motors than axles, and if the tractive effort is to be as large as possible. Although the division into a number of small units is easier in the case of the electric motor than in that of the steam engine, yet recently, as already mentioned, electric locomotives have been designed with a few large motors, placed at a high level, and with a driving shaft.

The reasons in favor of placing the motors higher up are as follows: First, more space is available, hence it is possible to have fewer and larger motors, and these are more readily accessible; second, better efficiency is obtained if there are fewer but larger motors; third, the motors are supported more elastically, by the springs between the locomotive frame and the running gear. It was all the easier to act in accordance with these reasons, as the question of placing the center of gravity high had already been tested in the case of steam locomotives, when the expected disadvantages had not appeared; on the contrary, smoother running resulted. As against these advantages, the disadvantages in the case of the electric locomotive are the introduction of the power-consuming system of rods and the greater difficulty of running 'round curves.

I have described this somewhat in detail, in order to show by a practical instance the general truth of the principle that advantages are always combined with disadvantages. It is readily intelligible that as these act in opposite directions, the balance of economic advantage may sometimes be on the one side, but sometimes also on the other, and that hence every device has its own proper field of application, in which it must be used, if proper economy is to result.

This thought was brought back to my mind when I saw the fine display of steam locomotives, as compared with electric locomotives, at the international exhibition at Brussels in 1910. If it be true that the steam locomotive is doomed, then these great works of not only German, but also of French, and Belgian steam locomotive builders, would be unintelligible because they would only represent a dead loss. But to me these exhibits were a proof of the correctness of the opinion that the electric locomotive is free to become developed within its own proper field of action, but that it is by no means to be considered as presumptive sole ruler in the field of land transport.

Before I proceed to show that the advantages of the steam locomotives must not be undervalued, and that they have not yet reached the limit of possible development, I will, in the first place, make some general remarks and exclude conditions for which the steam locomotive is not suitable.

Transport on land, which is what we are here considering, involves mechanical work, in order to overcome difference of level, friction and resistance of the air. This work can by the use of natural powers. At the present we have large be done by the muscular power of men and animals, and also ternal-combustion motors of all kinds, etc.

I will, in the first place, consider water-powers. It is only during recent years that these have been utilized for land transport. The main difficulty was that the place where the mechanical energy of the water-power is obtained is stationary, while the place where it is consumed moves. Hence, it is necessary to convey the energy to the place where it is consumed. Forces and accordingly also energy can be transmitted by means of solid bodies, by means of liquids (water), and by means of gases (air), and also by conversion into electric energy. Transmission by means of solids is effected in the case of cable railways, and by means of water when that is used as counterweight on mountain lines. The pull on the rope and the pumping of the water into the counterweight tank can be effected by a water-power plant, which may be placed, in the latter case, at a lower level. These two methods are only practicable for very short distances and do not affect long-distance traffic. For the same reason, we do not mention other similar methods of transmission of such water-powers. Just as little is transmission by means of compressed air of importance; this has lately been applied in America and also on lines inside mines and for tunnel-building purposes. The compressed-air locomotive is very similar to the steam locomotive, but the boiler is filled with compressed air. The compressed air can be supplied by a water-power plant, and the locomotive must return to it after a certain period in order to be recharged; hence its range of action is rather limited. The compressed-air locomotive can be compared with an electric locomotive worked by storage batteries. The one is charged at its central power station with compressed air, the other, with electricity, and then they run until their supply of energy is used up. This system of transmission can only be economic under very special conditions, and is only mentioned for the sake of completeness. The compressed-air locomotive belongs to the class of so-called "fireless" locomotives, and I do not propose to consider it or other compressed-air systems further here.

Electric transmission supplies a means of conveying large quantities of energy by means of a conducting wire, and, moreover, it is possible to take energy from any point of the wire and do so continuously. Accordingly, it is comparatively simple to supply the moving locomotive with energy from a stationary water-power station. The conversion of the mechanical energy of the water-power into electric energy forms, it is true, a complication, but one fully justified by the possibility ol having a very simple transmission.

Following out this train of thought, one recognizes that water-powers in connection with electric transmission of energy should, in the first place, be utilized to obtain the necessary mechanical energy for land transport, and as we know attempts are being made to reserve the water powers for this purpose, and only consider other industrial purposes in the second place. Although the range of action (and consequent possibility of economic operation) of electric transmissions is materially greater, yet it is limited, and such installations will only be made in the neighborhood of mountainous districts where there is sufficient reliable water-power available. In great plains, in dry countries or in those where there are long periods of frost, such installations become less economic and less practicable, particularly if other sufficiently ample sources of energy are available in those countries. Hence, it happens that in Upper Italy and

in Switzerland, where ample and reliable water-powers are to be found, while there is but little fuel, the introduction of electric railways has made the greatest progress.

Allowing the possibility of the exhaustion of the store of fossilized fuel in the world, it is absolutely necessary to devote the greatest attention to the utilization of the water-powers from the point of view of the world's economy. Water-powers have until now been utilized too little for the general benefit, and there were several reasons for this, namely: First, the water-powers are often placed in inhospitable regions; second, a great expense is involved in utilizing them; third, often they are unreliable; at times there are floods, at others there are droughts, or the supply of power is wholly or partially stopped by frost. The electric transmission of energy seems to have overcome the first-named difficulty to a large extent. The increasing amount of capital, the continually-growing demand for energy are overcoming the two other difficulties more and more. Indeed, the influence of demand and of capital will lead more and more to the adoption of artificial means, for instance the construction of dams across valleys, for making existing water-powers more powerful or for creating new water-powers. The more the nations advance in their social development, which is always tending to increase, the more expensive, though still economical, will the constructive works become which are required for making the water-powers available.

In spite of this, the steam locomotive is still in use in such districts, and the reasons for this are: First, there has not yet been enough time to introduce electric traction; second, as already mentioned, much capital is required for developing water-powers, if indeed reliable water-powers are still available. But if in addition to the expensive water-power plant it is also necessary to have a reserve plant, this naturally reduces the economy materially, and then the steam locomotive, in spite of higher working expenses, becomes more economic, as less is required for interest and amortization of capital. But this only applies as long as there is no shortage in the supply of fuel. From the point of view of the world's economy, it is very desirable to utilize the water-powers.

I now proceed to consider the second source of energy available; that is the store of fuel. Fuel is found in the solid state as wood, coal, peat, etc., and in the liquid state as oil. Natural gas, which occurs, is of comparatively small importance. The heat which is stored in this fuel can be transformed into mechanical energy by means of appropriate machines; steam engines and internal-combustion motors are used for the purpose. Of the latter, oil motors and Diesel motors are of most importance. In the first place, I will consider the steam engine burning coal, and thus begin to treat the chief subject this paper is dealing with.

The heat stored in the coal can be and is at present transformed in two ways into mechanical energy for purposes of land transport. Firstly, in the well-known steam locomotive, and secondly, in the electric locomotive. In the latter case, the heat of the coal is utilized in a stationary plant (central power station) to work a steam engine producing electric energy; the latter is conducted through a wire to the electric locomotive and is there again converted into mechanical energy. The steam locomotive and the electric locomotive may be directly compared as adhesion locomotives; but while the steam locomotive is a primary machine—that is to say, is self-contained—the electric locomotive is a secondary machine which has always to remain connected with the source of power and the conductor. Thus a direct comparison is not possible, but it is only admissible, from the point of view of economy, to compare the steam locomotive on the one hand with the complex, on the other formed by the electric locomotive together with its conductor and central power station.

Instead of the central water-power station, previously considered, we now have a central steam power station in combination with the electric locomotive.

In order to show the connection in a simple and generally comprehensible way, let us assume a central steam-power station arranged in such a way that a steam locomotive is stationary, and that its wheels, which are free to revolve, are coupled with a dynamo. From this dynamo the conductors pass, with the interposition of a switchboard, to an overhead line, from which the electric locomotive takes the current which has been generated. This illustrates the considerable complication which results, if steam-locomotive working is to be replaced by a central steam-power station and electric-locomotive working. I only wish to add that it is not so absurd as it might seem, to place a locomotive as a stationary engine in the central power station, for locomotives have repeatedly been converted into stationary engines, and finally, there are many electric power stations in which locomobiles are working, which are closely related to locomotives. The locomotive is in fact nothing but a steam engine and boiler combined.

Carried out in this way, there would of course be no possibility of the electrification of the railway from the economical point of view; but starting with this arrangement I will show how the disadvantage of the complication may be more or less counterbalanced by the advantages which a stationary steam plant possesses as compared with the moving locomotive. Even if no alteration is made, there are advantages to be set against the greater complication. These are: First, fuel and feed water have not to be carried on the locomotive; second, the management of the electric locomotive is much simpler, as the current is supplied ready and can be distributed with great ease. Hence, all operations can be carried out by means of one hand lever. As the electric locomotives generally have compressed air or vacuum brakes, like steam locomotives, there is no difference in this respect; third, the electric motors of the electric locomotive have a rotary movement and hence the force transmitted to the periphery of the driving wheels does not vary. A four-cylinder steam locomotive does not show such great variations in its tractive effort that an electric locomotive could be expected to have a greater tractive power and to be able to go up steeper gradients, as is often asserted; for it can only be a question of a small difference which in any case cannot act as a decisive factor, as both locomotives are adhesion locomotives, and their tractive effort on a gradient is reduced to a corresponding extent as the normal pressure on the rails is reduced; fourth, it is comparatively easier to have large and powerful motors on the locomotive, as any desired amount of current may be generated at the central power station and conducted to a locomotive. As the steam locomotive carries with it its own power station, it is more difficult to make it more powerful. But in both locomotives the limits are set by the track, namely by the gauge, the radius of the sharpest curve and the highest admissible wheel-load. As the electric locomotive also has a system of rods today, it has lost the ease of running 'round curves which characterizes motor cars, and actually the same devices are utilized to enable it to run 'round curves, which have for a long time been successfully used in the case of steam locomotives.

[To be continued]

Personals

A. L. Filmore has been appointed master mechanic of the Northern district of the Minneapolis, St. Paul & Sault Ste. Marie, with office at Stevens Point, Wis. C. F. Gillaspy has

been appointed traveling engineer with office at the same place. A. V. Birch has been appointed master mechanic of the Southern district.

T. M. Ramsdell has been appointed master car builder of the Chicago & Alton with office at Bloomington, Ill. He succeeds H. E. Smith.

P. Alquist has been appointed general car inspector of the Pere Marquette with office at Grand Rapids, Mich., succeeding W. H. Rourk. E. W. Hartough has been appointed general car inspector with office at the same place.

Robert Sansocie has been appointed superintendent of motive power of the Cache Valley with office at Sedgwick, Ark.

W. J. O'Brien has been appointed master mechanic of the Kanawha & Michigan with office at Hobson (Middleport postoffice), Ohio.

J. J. Waters has been appointed superintendent of motive power of the Pere Marquette with office at Grand Rapids, Mich., succeeding W. L. Kellogg.

T. M. Ramsdell.

Thomas J. Foley, formerly assistant general manager of the Illinois Central, has been appointed general manager with office at Chicago. He takes over a portion of the duties of W. L. Park, who has acted as vice-president and general manager. J. M. Daly succeeds G. W. Berry as superintendent of transportation with office at Chicago. Mr. Berry becomes general superintendent with office at Memphis.

E. E. Turney has been appointed district car foreman of the eastern division of the Minneapolis & St. Louis at Marshalltown, Ia.

A. H. Young has been appointed general storekeeper of the St. Louis & San Francisco, succeeding J. R. Mulroy, resigned. His headquarters are at Springfield, Mo.

J. R. Mulroy has been appointed general storekeeper of the Pullman Co. with office at Pullman, Ill.

James McCrea has resigned as president of the Pennsylvania and is succeeded by Samuel Rea.

W. D. Trump, who until recently was general superintendent of the Pere Marquette, has been appointed manager of the Detroit Terminal with office at Detroit.

A. L. Moler has been appointed master mechanic of the Charlotte Harbor & Northern with office at Arcadia, Fla. He succeeds H. D. Jackson, who has resigned on account of poor health.

W. C. Sealey has been appointed assistant master mechanic of the Grand Trunk with office at Toronto, Ont. G. M. Wilson succeeds Mr. Sealey as general foreman at the Toronto shops.

J. J. Waters.

C. M. Whitney, general car foreman of the St. Louis & San Francisco, has been transferred from Chaffee, Mo., to Memphis, Tenn.

W. T. Davis has been appointed superintendent of air brakes of the Chicago & Alton with office at Bloomington, Ill.

J. S. Motherwell has been appointed master mechanic of the Louisiana & Northwest with office at Homer, La. He succeeds J. B. Stewart.

F. W. Scott succeeds T. B. Weaver as purchasing agent of the Louisiana & Pine Bluff with office at Huttig, Ark.

C. V. Elberson succeeds James McKenzie as foreman painter of the Toledo & Ohio Central at Bucyrus, O.

W. E. Stavert has been elected president and general manager of the Alaska Northern, succeeding O. G. Laberee.

Hugh Gallagher, formerly road foreman of engines, has been appointed master mechanic of the Santa Fe at La Junta, Colo., succeeding H. T. Peyton.

C. D. Baldwin has been appointed purchasing agent of the Bangor & Aroostook. His office is at Milo Junction, Me.

E. C. Hanse has been appointed acting master mechanic of the Georgia & Florida, succeeding J. F. Sheahan, resigned. His office is at Douglas, Ga.

H. Clewer.

J. F. Sheahan has been appointed superintendent of motive power of the Atlanta, Birmingham & Atlantic with office at Fitzgerald, Ga. He succeeds R. L. Doolittle.

R. P. Dalton, formerly of the Chesapeake & Ohio, has been appointed superintendent of the Pere Marquette with office at Grand Rapids, Mich. He succeeds F. Hartenstien, resigned.

Finley J. Shepard has been appointed assistant to the president on the Missouri Pacific-Iron Mountain System, in addition to his present duties as assistant to the president on the Denver & Rio Grande. Mr. Shepard entered the railroad service in 1889 in the general offices of the Northern Pacific at St. Paul. After he had advanced to the position of assistant general manager of the Northern Pacific, he left the road in 1901 to go to the Atchison, Topeka & Santa Fe at Chicago. The following year he was made general superintendent in charge of the Coast Lines of the Santa Fe, with headquarters at Los Angeles. Mr. Shepard remained in this position for three years, when he left to engage in private business in a line which kept him in close touch, however, with railroad affairs. In June, 1911, he came to the Missouri Pacific as assistant to the first vice-president in charge of operation. When Mr. Bush, president of the Missouri Pacific, was also chosen to head the Denver & Rio Grande, in January, 1912, Mr. Shepard was selected as his assistant on the latter road and has filled that position since.

Clinton B. Conger.

W. L. Kellogg has resigned as superintendent of motive power of the Pere Marquette to accept the position of superintendent of machinery and equipment of the Missouri, Kansas & Texas with office at Parsons, Kan. He succeeds Wm. O'Herin.

B. L. Wheatley succeeds H. Clewer as master mechanic of the Chicago, Rock Island & Pacific, with office at Fort Worth, Texas.

H. Clewer has been appointed superintendent of locomotive operation of the Chicago, Rock Island & Pacific Ry., with headquarters at Chicago. This is a new position which has been established with a view of effecting further economies in the use of locomotive fuel, lubricating material and locomotive supplies. Mr. Clewer was born March 30, 1869, at Jackson, O., and began railroad work as a machinist's helper in 1888 on the Kansas City, Osceola & Southern Ry., remaining with that company until June, 1894, as a locomotive fireman and engineer. In 1894 he entered the service of the Chicago & Alton as a locomotive engineer and later became road foreman of engines and master mechanic. He resigned in May, 1912, to enter the service of the Rock Island as a locomotive engineer. He has since served continuously with this road as roundhouse foreman, road foreman and master mechanic until his present appointment.

OBITUARY.

Howard James, director of purchases of the Great Northern, and S. B. Plechner, purchasing agent, were killed in an automobile accident near St. Paul on November 24.

Howard James.

M. A. Malloy, master mechanic of the Pennsylvania at South Pittsburgh, Pa., died on November 3d.

Reuben Wells, a well known old time railway man, died at Paterson, N. J., on November 8, at the age of 83 years. He was president of the American Railway Master Mechanics' Association from 1882 to 1884.

Clinton B. Conger, treasurer of the Traveling Engineers' Association and one of its founders, died on October 29 at the age of 65 years. He was a traveling representative of Wm. Sellers & Co. and was a well known and familiar figure at the meetings of the Traveling Engineers' Association.

Among The Manufacturers

VAN DORN CAR END.

In these days, when the question of damaged box cars is receiving serious attention, devices for decreasing the cost of repairs and for doing away with the necessity of repairs are receiving marked consideration. One of the most meritorious devices of this nature is the Van Dorn one-piece steel end for both new and damaged box cars. It is made of heavy steel, the larger portion of which is corrugated by a number of concentric rings, thus giving it a bull's-eye appearance and at the same time making it much stronger than a flat piece of steel. The whole end, including the flanges, is pressed out by one operation of the press and the ends can be flanged to fit any class of car. Its strength, of course, greatly exceeds that of any

Rock Island Cars with Van Dorn Ends, Leaving Repair Shop.

wooden end which could be built in a car, and as this is the point where a large percentage of cars are damaged, it affords a better protection to the contents of the car. At the same time it does away with posts, braces and rivets, as none are required in the end, and allows a foot more space inside the car. It also keeps the car in perfect alignment.

The application of these ends to old cars sent in for repairs greatly prolongs their life and, in fact, makes them as good as new. The illustration shows a number of Rock Island cars leaving the shops after having been equipped with Van Dorn ends, and their appearance speaks for itself. When these cars were sent in for repairs they were in a very delapidated condition. Nearly three years ago a Southern Pacific car was equipped with a Van Dorn end and at its recent return to Chicago for a few days it appeared to be in as good condition as when it first started out. The end is more quickly and inexpensively applied than the ordinary end, and is in use on a number of roads, including the Illinois Central, the Southern Pacific and the Rock Island. It is manufactured by the W. T. Van Dorn Co., 2332 South Paulina street, Chicago.

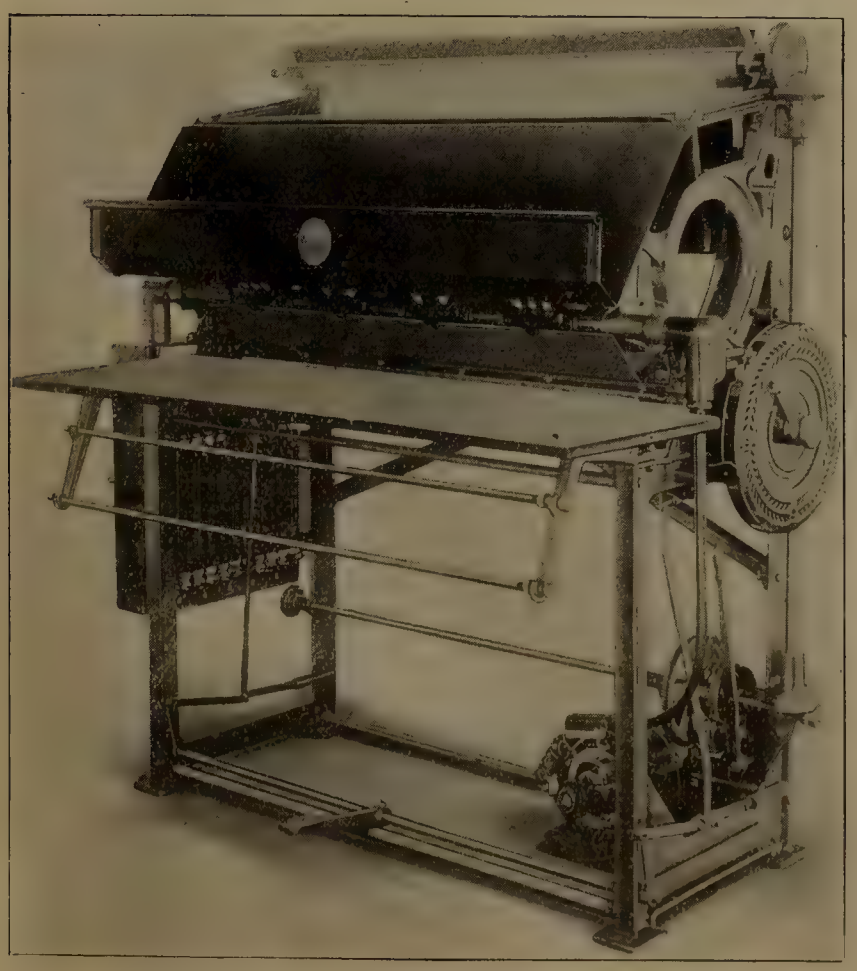


Fig. 1—Continuous Electric Blue Print Machine.

AUTOMATIC BLUE PRINTING MACHINE

Great advances have been made within the past two years in the manufacture of continuous automatic machinery for producing high-grade blue prints rapidly and at low cost. The Peerless blue printing machinery, illustrated herewith, is manufactured by the C. F. Pease Co., 166 West Adams street, Chicago. These machines have been on the market for the past two years and, it is stated, are now being used with great satisfaction by many of the leading railroads and manufacturers of the United States and Canada. They were especially designed for general practicability for all classes of electric printing, and with especial reference to low operating and maintenance expense. These machines are manufactured in a variety of sizes, with varying capacity to suit the largest or smallest engineering department.

The accompanying illustration, Fig. 1, shows the Pease Peerless blue printing machine ready for operation. The paper may be printed either in sheets or in rolls as desired. Two spindles are provided underneath the feeding table for carrying different widths of paper. The paper and tracings are carried upward by means of an endless canvas belt past a bank of arc lamps. The tracings are returned direct to the operator's hand, and the exposed paper may be returned in the same way or pass over the top roll of the machine. Unlike all other continuous printing machines, the exposed paper may be immediately seen and the exposure increased or decreased instantly by moving the finger on the dial of the rheostat placed conveniently on the right hand end of the machine.

No transparent bands or expensive glass cylinders are used, but there is a short segment of heavy plate glass, which is so hung and adjusted that breakage is declared to be practically impossible. Tension springs at either end of the machine automatically take up the stretch of the endless canvas belt, so that perfect contact is obtained at all itmes, while a special patented device prevents all side travel of the belt.

The arc lamps were especially designed for this machine. They are connected in at the bottom, and each lamp is provided with an aluminum reflector. The resistance coils are carried away from the lamps underneath the table, thereby producing a more uniform light and largely reducing the heat. All wiring is encased in steel tubing, and each lamp and motor is independently connected, the switches being enclosed in a metal box at the left hand end of the machine. By means of the individual connection it is necessary to use only a sufficient number of lamps to cover the tracing being printed, thus producing a large saving in electrical energy. No friction discs or belts are used, all speeds being electrically controlled directly through the motor. Any possible speed can be obtained between four inches per minute, which

is slow enough for the heaviest negative, and six feet per minute, which is as fast as tracings can properly be handled. A fan is provided for circulating the air, as shown on the left hand end of the machine.

Figure 2 shows the Pease Peerless printer connected with the Pease automatic washing and drying machine. This apparatus occupies a space only 5½x6½ feet, and with it it is possible for one operator to print, wash and dry 100 yards of finished blue prints per hour, delivering them free from wrinkles and distortions at the end of the dryer, automatically wound up in a loose roll, ready for use. The paper is fed in one continuous roll, the tracings being returned direct to the operator's hand, and the exposed paper passing over the top roll of the printing machine into the washer, where it is first washed by a spray of clear water, then by a spray of potash water, which is pumped over and over from the tank shown in the rear of the machine, and lastly by a spray of clear water, after which the paper passes up over the dryer and down into the winding-up device, as shown in Figure 3.

When the apparatus is not in use it is customary to keep it threaded up with a strip of blank paper, one end extending onto the feeding table of the printer, and the other end into the rewinding device. After the run is finished the leader is placed on the spindle under the tracing table, the end pasted to the end of the roll of sensitized paper, the machine being allowed to run until all of the prints have passed into the winding-up device and the leader is again in the machine ready for starting. The apparatus may be provided with gas or electric dryer as desired. The illustration shows the electric dryer.

The C. F. Pease Co. also manufactures a combination machine, with which may be produced either blue prints or the Pease direct blue line prints, changing from one to the other without stopping the machine.

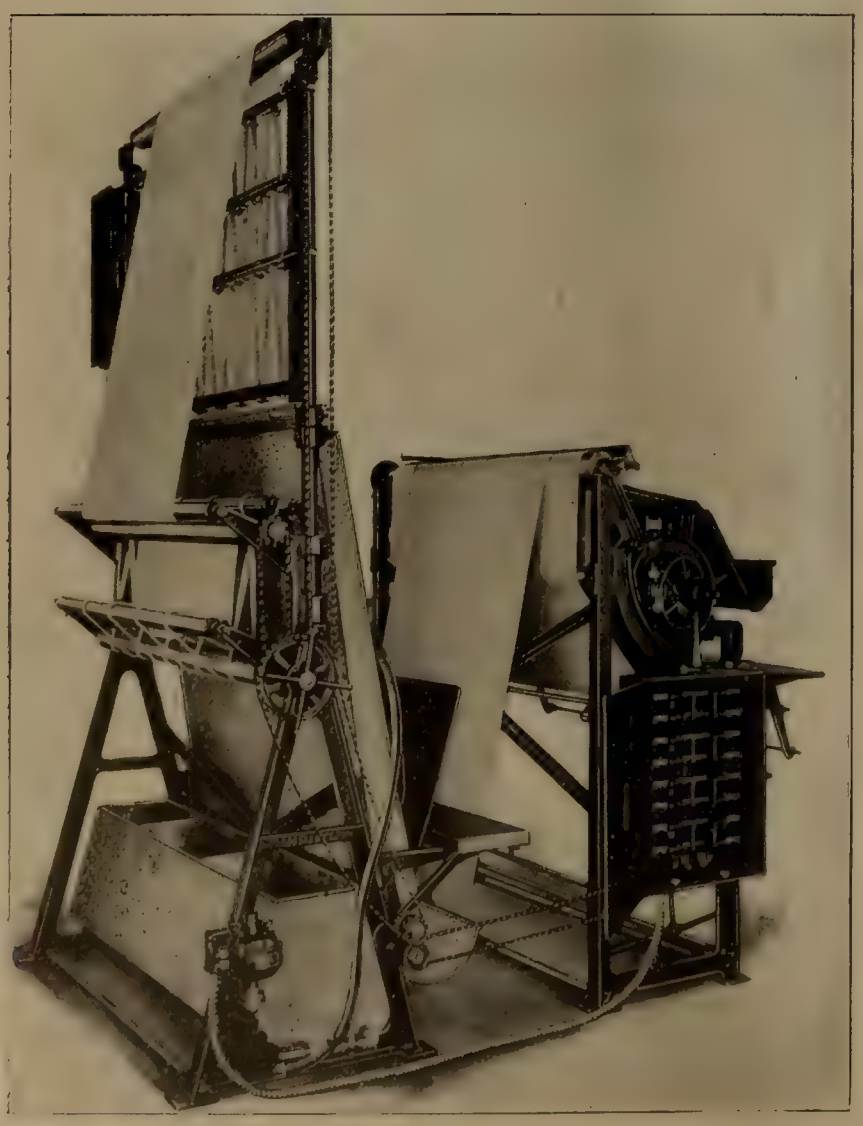


Fig. 3—Side View of Printing and Washing Machine.

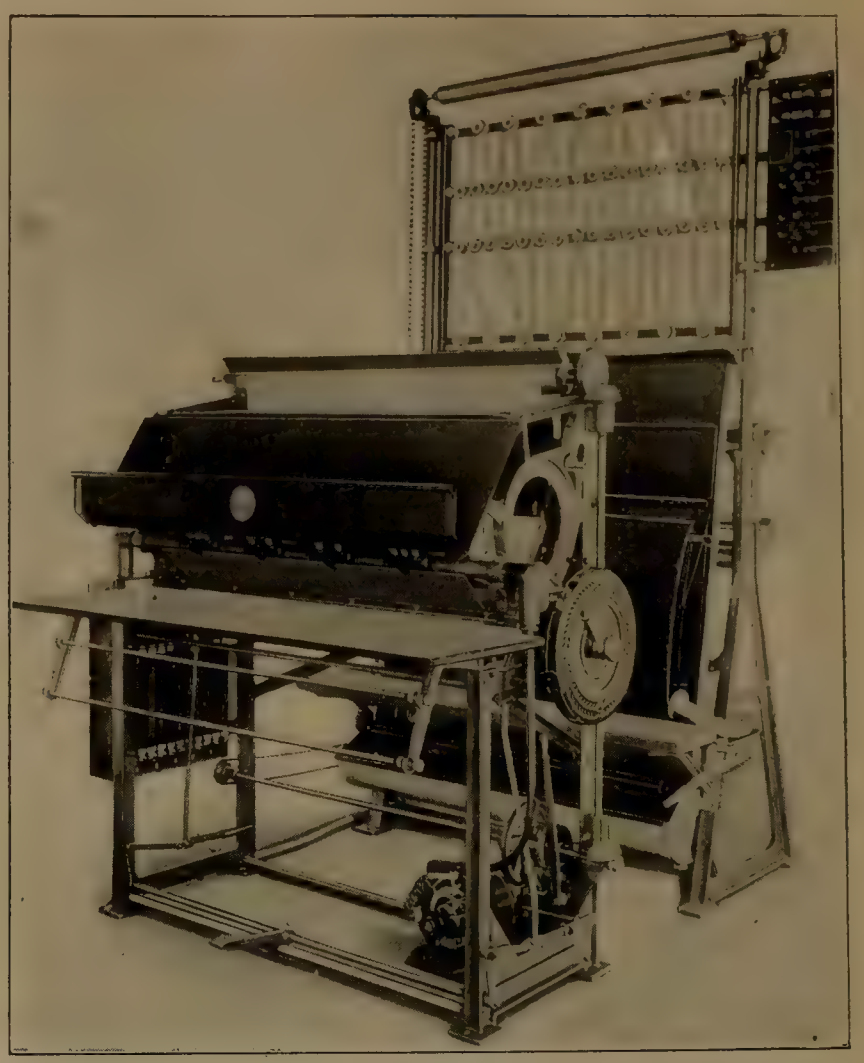


Fig. 2—Blue Print Machine Connected with Automatic Washing and Drying Machine.

MESTA FORGING PRESSES.

While hydraulic accumulator presses have been in use in the United States for several decades, the steam-hydraulic or direct acting intensifier press, is of rather recent origin and has been developed in Europe. The success of this type on the other side of the Atlantic has caused several American manufacturers to take up this class of work, but the Mesta Machine Company of Pittsburgh has introduced a type which in accessibility and straightness of force action equals or even surpasses the steam hammer.

The press illustrated was originated by the firm of Haniel & Lueg, of Dusseldorf, Germany. The exclusive right for building these presses in the United States and in Canada was acquired, two years ago, by the Mesta Machine Company.

Fig. 1 shows two of the presses built by the Mesta Machine Company for general forging purposes. The operating lever for the large press is shown at the left of the picture. It will be noticed that the press is accessible from all sides for the use of shear tools, die holders, etc.

Figure 2 shows front elevation of the press with sectional view of the cylinders. The press consists of a heavy base "U," four columns. "X" and the stationary crosshead "Y," which contains hydraulic cylinder "P" and hydraulic balancing cylinder "F." The pistons of the balancing cylinders "F" are connected to the movable crosshead "H" by the piston rods "G." The pistons of the steam cylinders "R" are connected to the extension of piston rods "G." The air chamber "W" is partly filled with water and is connected to hydraulic cylinder "P" with check valve "V" in the connecting pipe. The balancing cylinders "F" are connected directly to the air chamber. "A" is a single-acting steam cylinder. "T" and "S" are the top and bottom dies.

Hydraulic cylinders "P," balancing cylinders "F" and about one-third of air chamber "W" are filled with water. The air chamber is then pumped up to a pressure of about one hundred pounds, which is sufficient to move piston rod "C" and piston "B" to the top of steam cylinder "A" when there is no pressure in the steam cylinder. The pressure on plunger "D" is always

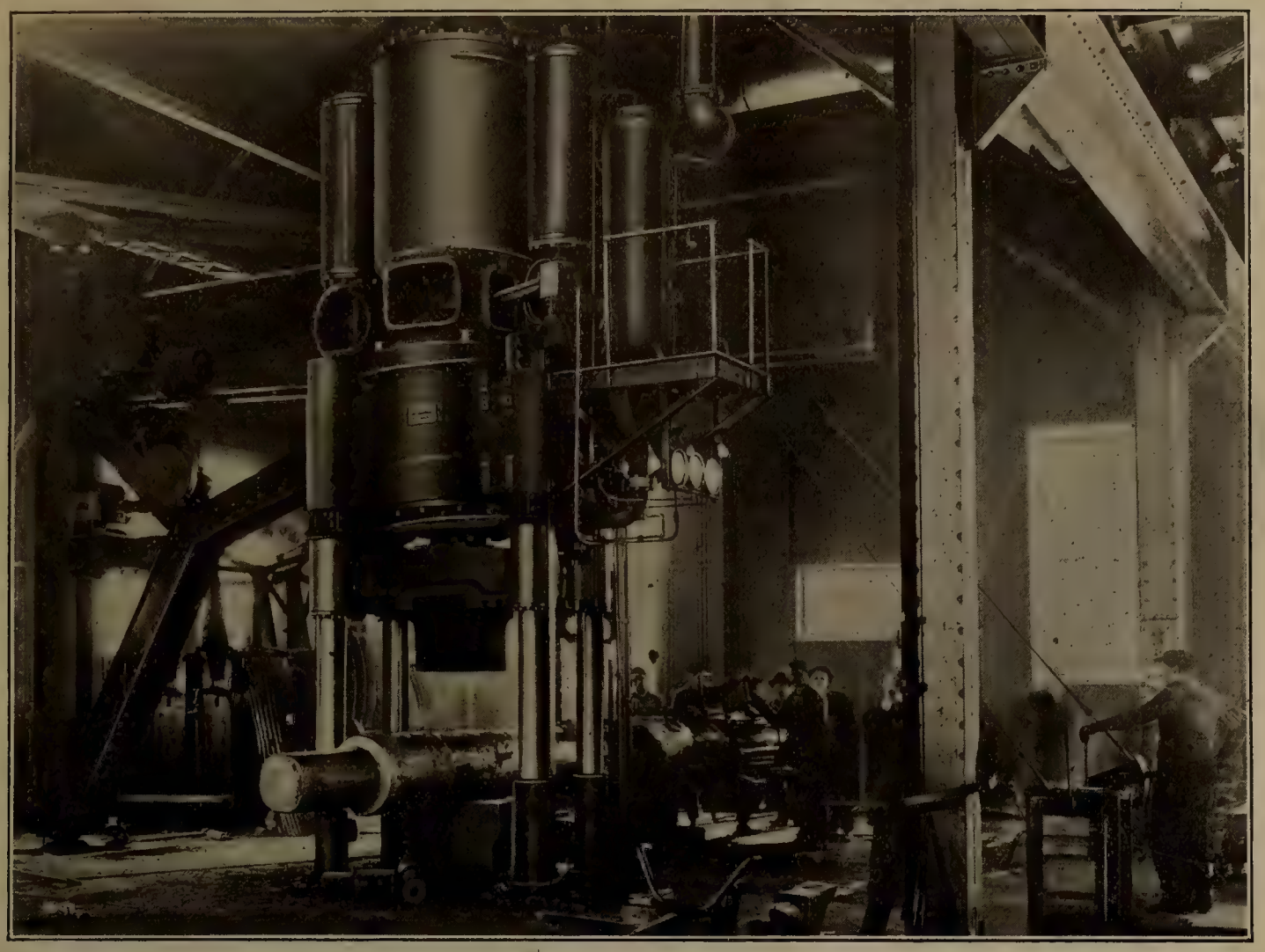


Fig. 1—Mesta Press for General Forging Purposes.

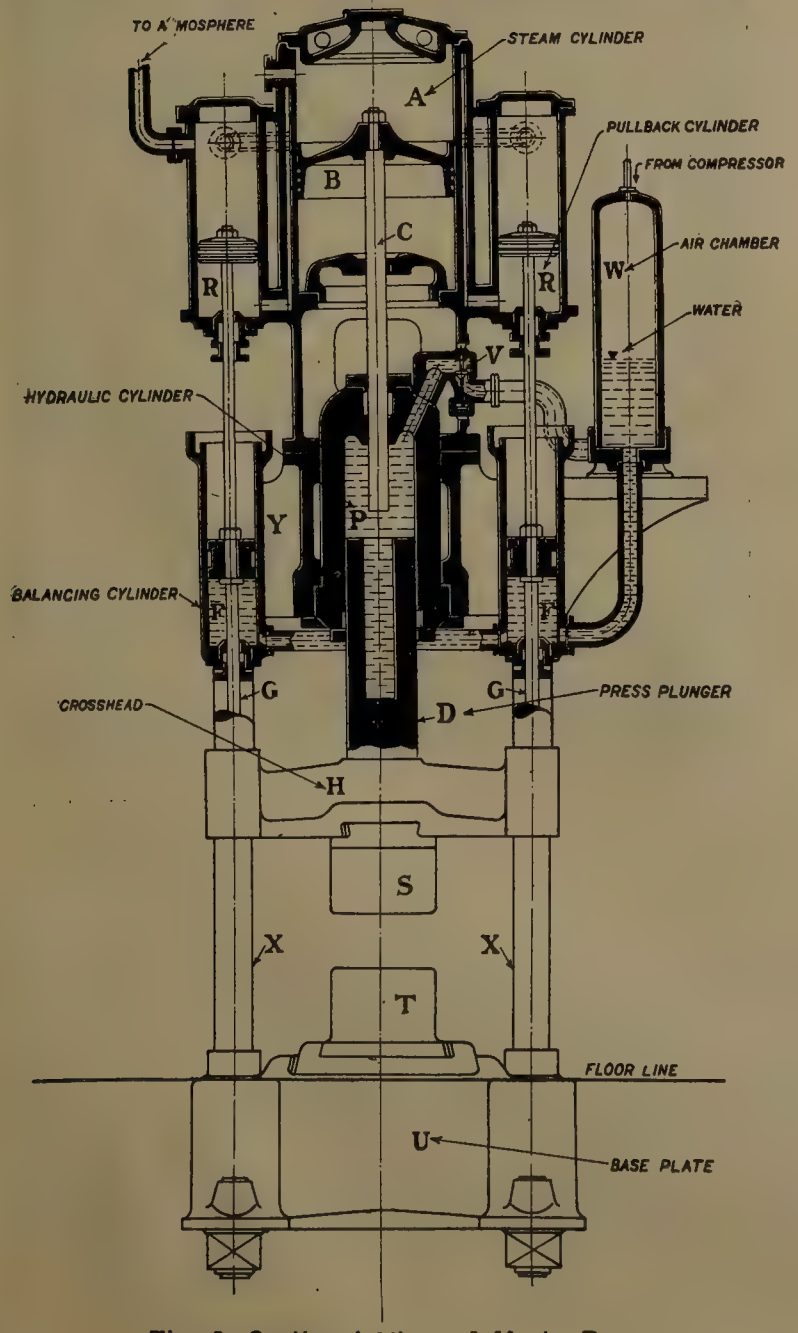


Fig. 2—Sectional View of Mesta Press.

balanced, as the area of the two cylinders "F" is equal to the area of cylinder "P." By admitting steam to cylinders "R," the crosshead "H," which contains die "S," can be moved upward to any point by lifting check "V" and allowing water from cylinder "P" to flow into air chamber "W." When die "S" is at proper height check valve "V" is closed. The press is then ready to take the piece to be forged between dies "S" and "T." By admitting steam to cylinder "A" piston rod "C" is forced into cylinder "P," which gives the necessary pressure to do the forging. As soon as the steam is exhausted from cylinder "A," piston "B" and crosshead "H," automatically move to their positions ready for the next stroke.

The all around accessibility of the press and the small requirement of floor space is coupled with a slightly greater requirement for the head room. The word "slightly" is used on purpose, because on presses which place the steam intensifier on the floor, the pull back or balancing cylinders take up a considerable amount of head room which is only very little increased in the Mesta press by the central intensifier. A glance at Figs. 1 and 2 proves the correctness of this contention.

"BRUSH-BAR" BELT DRESSING.

The greatest element in the insurance of long life to a belt is its proper care and lubrication. A belt is not properly cared for by applying dressing, no matter how good its quality, unevenly to the belt surface and without first cleaning the belt before it is applied.

There is no factor of economy in machine shops, or any place where belts are used, of greater worth than the right kind of belt dressing rightly used. This point should compel as much attention from efficiency engineers as any other item. Any consulting engineer making a complete report upon a large plant will go to the bottom in his belt dressing investigation. He will see that the article used is analyzed and found to be free from rosin, pitch, and all foreign matter injurious to belting. The "brush-bar" belt dressing, made by the Wavo Manufacturing Company, Buffalo, N. Y., invariably receives approval

when an analysis is made; added to this, its unique and most convenient form obtains immediate recognition.

"Brush-bar" belt dressing is put up in cylindrical form, one full pound of dressing to each bar; the bar is of two inches diameter to easily fit the palm of the hand, thereby insuring economy in making it possible to use up the very last bit of the dressing. All users of belt dressing have been more or less prejudiced; the prejudice is right when dressings are full of injurious substances. Engineers, perhaps, have a right to complain, too, if the form of application is not handy and practical, a point which is overcome in the form in which this article is furnished.

"Brush-bar" Belt Dressing.

Failure to remove dirt before application of the dressing is the cause of much trouble and criticism of belt dressing, which the dressing does not merit. Workmen do not realize this, but, when they get a stick of "Brush-bar" belt dressing, the suggestion is there to clean the belt by first applying the leather brush end of it while the belt is running and removing the dirt from the belt. Then the stick is reversed and the dressing is applied to the belt in easy, convenient, time-saving form, and, what is more, the entire surface of the belt is evenly treated to the dressing; thus, the cleaning of the belt is done without trouble or delay. The brush serves as a handle to the bar of dressing and permits the use of the entire stick without waste.

LARGE METAL SAW.

The Hunter Saw & Machine Co. of Pittsburgh, Pa., has recently manufactured, it is said, two of the largest inserted tooth metal cutting saw blades ever placed on the market.

These saws are eighty-four inches in diameter and are made from one inch thick plates treated to withstand the greatest strain. Two collars, one on each side, twenty-six inches in diameter and one inch thick, are riveted to body of saw, and are milled with four equally spaced keyways by which the blades are driven.

Large Size Hunter Saw Blade.

The plates are milled with forty-four pockets into which are inserted roughing and finishing teeth alternately, weighing 1¾ pounds each, and made of the best grade of high speed steel for metal cutting. Each tooth is reinforced and held rigidly by a tool steel wedge, weighing ¾ pound, inserted at the back of tooth. At the bottom of pockets the plate is drilled and tapped to admit of a hexagon head brass screw which is used in setting the teeth to the proper height.

The blades weigh 2,000 pounds each, are driven by 75 horsepower motors, and were designed for cutting 40-inch ingots. They are claimed to be capable of cutting through 24-inch ingots in ten minutes.

SCOTT ADJUSTABLE CAR SCREENS.

The original car screen used in Pullman sleeping cars and in dining cars was simply a wood frame about 7½ inches high with a wire mesh attached to same and placed under the car window. In Pullman sleeping cars and dining cars where double windows were used this screen was placed under the outside window and the inside window raised to admit the air. The result of this mode of screening necessitated the raising and lowering of the inside windows for the regulation of the air current. The imperfections in this method of screening induced the adoption of a different idea, getting entirely away from the "Under the window" screen and eliminating the question of storage room in cars. This screen was placed between the two windows and slides the same as the window in a perpendicular manner.

Outside Car Window Constructed with Glass Shutters.

The American Car Screen Co. of Pittsburgh has now brought out the "Scott" adjustable car window screen which is one of the latest ideas in screens, and is in harmony with modern progressive ideas. The inventor of this screen, having had a large experience in traveling throughout the country in all kinds of railway cars, conceived the idea of constructing a car window screen that would not only meet all the requirements for the convenience and comfort of the traveling public, but also meet the requirements of the railway companies as regards the question of storage room for window screens. The illustrations will serve to show plainly what this individual adjustable car window screen is and that it can be made as an "Under the window" screen or it can be made as a part of the window itself, thus eliminating the

"Under-the-Window" Screen with Glass Shutters.

question of storage room. This screen, like many other new devices, has passed through several stages of improvement. Figure 1 shows this adjustable screen as it was first made, containing twelve oxidized metal shutters which slide back and forward from the center to the ends of the screen spaces. The figure shows both sections of the screen entirely open. When the shutters in this screen are closed the screen is air tight and dust proof, as the shutters lock when they are closed by means of a spring catch on the center shutters. This screen is shown as an "Under the window" screen.

Figure 2 shows the same style, also an "Under the window" screen, with the glass shutters instead of metal shutters. The use of glass shutters is a wonderful improvement in that it does not cut off any light in the car, is handsome in appearance and cannot rust under adverse weather conditions. The glass shutters used in this screen work exactly the same as the metal shutters and slide back and forward from the center to the ends of the screen sections affording the passengers a means of regulating the air current to suit their own desires. It has been demonstrated by practical tests in car windows that this screen will reduce dirt 50 per cent, when the shutters are altogether open. When the train is in motion, it causes an air suction that forces the dirt to come in at the bottom of the screen and at no other place, and a guard rail has been so constructed at the bottom of the screen that it forms a dust catcher and prevents the dust and dirt from entering the car windows. In dining cars this screen will keep table linen clean and is large enough to afford 230 square inches of air space, which is ample for any car window.

Figure 3 shows a complete car window constructed so as to receive the adjustable glass sections, and represents the outside window of the car. This window sash is constructed with two spaces in the lower section to receive the glass frames while the wire mesh is attached to the sash on the exterior. These spaces are counter-sunk so that the glass sections come flush with the sash frame and are so arranged that the glass sections are locked in the sash, but can be taken out when necessary to be cleaned. These glass shutters afford the passengers a means of adjusting the ventilation personally, and they can, with the tips of their fingers, close these shutters entirely or regulate the shutters any distance to suit their own convenience. They do not need to call the porter, they can work it themselves.

The inventor of this adjustable screen claims that the best results are obtained by this method of making it a part of the car window as shown in figure 3 and not as an "under the window" screen. This method supplies the car with a system for ventilation at all times, both summer and winter, and by keeping the inside window raised the passengers can regulate the ventilation to suit the conditions. To apply this adjustable screen in this manner the railway companies would have to construct new sashes in their old cars. This at first glance would seem to be asking them to undertake not only a huge task but an expensive one. When carefully investigated, however, it would not be so, as the construction of new sash with the "Scott" adjustable glass sections applied to same would not cost as much per window as the "Under the window" screen. This method also eliminates the troublesome question of storage room for screens in cars.

The "Scott" screen used as an "under the window" screen consists of a wood frame made of hard wood, finished in mahogany, oak, or cherry. The wood frame is made in two sections, hinged in the center as shown in the illustration. Where the sections are hinged together they are tongued and grooved, so that when the screen is placed in the car window, no dust or dirt can get in between the sections. Rubber tubing is used on the top and bottom of the screen frame. The back of the frame, or when it is placed in the window, the outside, contains a fine wire mesh, while the front or the inside of the frame is fitted up with glass shutters. These shutters in each section slide freely back and forward in bronze oxidized slides or runners. The glass strips used in the shutters are fitted into skeleton frames made of sheet bronze and oxidized, and give the glass an appearance of leaded glass. The skeletons that hold the glass strips serve to strengthen the entire construction and the question of breakage does not enter into consideration at all. Should such a thing happen in a wreck, it is very easy to slip in a new strip of glass. The glass strips in the large size screens measure 9 inches long by 3 inches wide, while in the small size screens they measure 9 inches long by 2 inches wide.

STREETER PIVOT JOURNAL BEARING.

A journal bearing, which is illustrated herewith, and which has original and desirable features, has been placed on the market by the Streeter Supply Co., Old Colony Bldg., Chicago.

This bearing is designed with a view of relieving the rigidity existing between the axle and the box when the ordinary M. C. B. standard wedge and bearing are used. The concave on the wedge and the convex on the bearing brass

"Under-the-Window" Screen with Metal Shutters.

Pivoted Journal Bearing.

with clearances between the faces of the members allows desirable lateral, rocking and pivotal movement.

Other advantages claimed for this bearing are: reduction of friction, reduction of flange wear, even wear on the brass due to the impossibility of its cocking, increased mileage. It is said moreover that the brass cannot be removed by thieves who depend upon the lever, block and jimmy.

"AMERICAN" SENSITIVE DRILL.

The "American" sensitive radial drill shown in the illustration, is designed and built for the purpose of providing a machine especially adapted to drilling and tapping small diameter holes at high speeds. Convenience in operating a machine of this type is an essential feature, as the time consumed in actually drilling a hole is often very slight in comparison with the time "between holes."

In this drill, all levers and operating members, are placed most conveniently for the operator. The feed lever, which is probably used more than any other operating member on the machine, is located on the head, directly in front, and on the right hand side, of the operator, its position making it convenient to operate, and also obviating any possibility of interference with the work "set up" on the table. Another advantage of the ratchet lever feed which is used, is found in the fact that when the lever is placed in its vertical position, it is automatically disengaged from the rack pinion shaft and the spindle can then be adjusted quickly up and down by means of a small star knob on the end of the rack pinion shaft. This feature is very quick and handy for bringing the drill to and from the work.

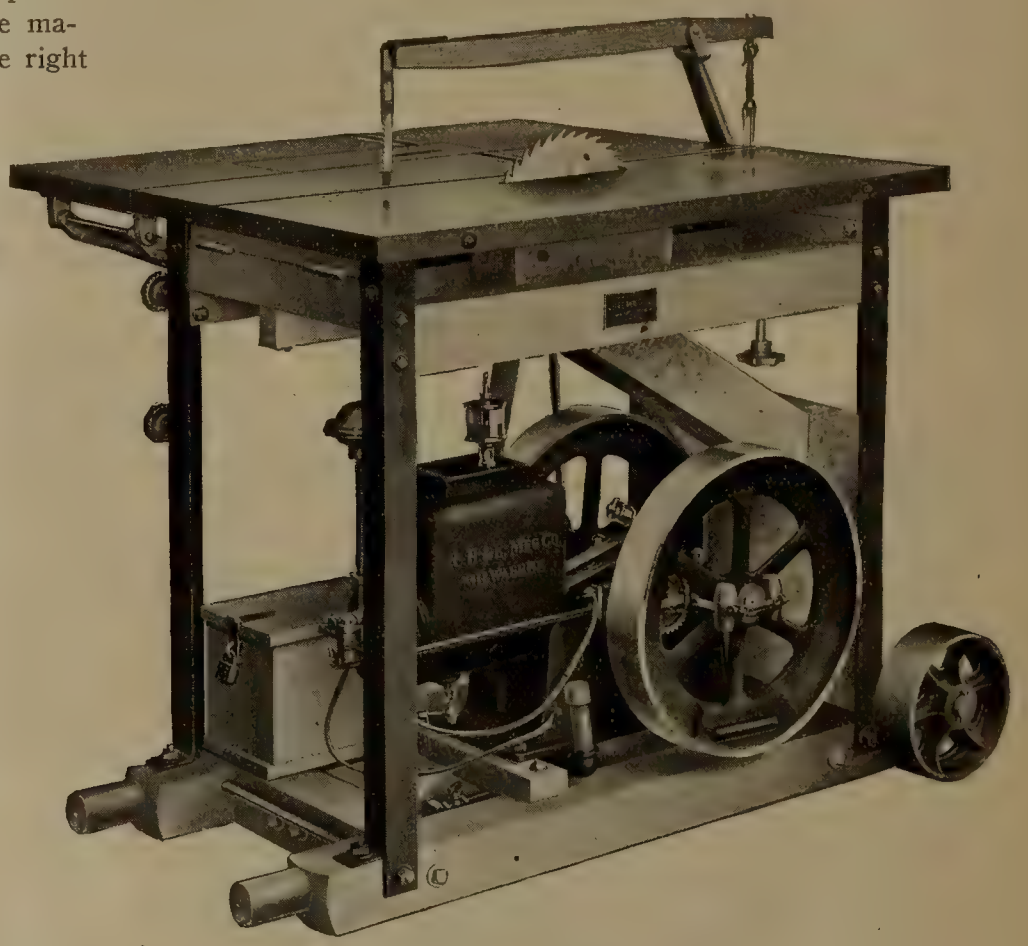
The head can be removed rapidly along the arm by means of a rack and pinion operated by a hand wheel. This hand wheel is located on the front of the head on the operator's left hand side, its location enabling the operator to swing the arm with his right hand, and at the same time to adjust the head along the arm with his left. The head consists of a main saddle, which has a bearing on the arm and carries an auxiliary sliding head upon a vertical dove tail. The sliding head is so arranged that it can be moved to or from the table, thus making possible the accommodation of quite a wide range of work.

This machine can be provided with either a stationary or movable table, or the table may be omitted and the machine furnished with a pedestal base. The drill is manufactured by the American Tool Works Co. of Cincinnati, O.

American Sensitive Drill with Elevating Table.

PORTABLE SAW RIG.

The gas engine has made possible many labor-saving devices and one of the latest is a portable saw rig manufactured by the C. H. & E. Mfg. Co., Inc., of Milwaukee, Wis. This outfit, shown in the accompanying illustration, is operated by a 4-h. p., four-cycle hopper-cooled engine, mounted on a pair of skids. Attached to these skids is the saw platform, the saw being belted to one of the engine fly wheels. Included among the attachments of this rig are a 12-in. rip saw, 12-in. cross cut saw, 8-in. diameter dado head, 4-in. joiner, jig saw, 8-in. emery wheel, 10-in. sander, and minor accessories. The outfit will rip 2-in. lumber and cross cut 3-in. lumber, and the total weight including engine is 697 pounds. By means of a pair of wheels mounted at one end of the skids, the outfit can easily be wheeled from one place to another and is very convenient for doing mill work and odd jobs of sawing at various places about the shop.



C. H. & E. Portable Saw Rig.

New Literature

B. E. Tilden & Co. has issued a folder descriptive of the well-known Tilden car and locomotive replacers. This firm has recently moved from Chicago to 17 Battery place, New York.

* * *

The Universal Nut & Bolt Lock Co. of Newport, Ky., has recently issued a booklet giving information concerning the Martin nut-lock.

* * *

Bulletin 11 of the National Tube Co., Pittsburgh, Pa., takes up two features of "National" pipe—the marking of the pipe and the Spellerizing process. The latter is a process of working the metal to produce a more uniformly dense texture.

* * *

An interesting catalogue has been issued by the C. F. Pease Co. of Chicago entitled "Everything for Blue Printing." This firm handles blue print machinery and sup-

plies, whiteprint machinery and drafting room furniture. The machines are designed to produce a large quantity of blue prints at a low cost for operation and maintenance, and are being adopted on leading railways. With the combined printing, washing and printing, all the operator has to do is to start the machine and feed in the tracings; the machine turns out the finished prints.

* * *

The Smooth-On Mfg. Co. of Jersey City, N. J., has just issued a new edition of its Smooth-On Iron Cement book No. 7. This cement is a hydraulic, chemical iron cement, prepared and sold in powdered form and used for waterprooofing, stopping leaks of concrete, hardening concrete and for bonding concrete to concrete and brick to brick or any porous substances. This new instruction book is illustrated, the illustrations showing a few of the many ways in which this cement has been used and the results obtained.

* * *

The Zug Iron & Steel Co., of Pittsburgh, Pa., has issued in handy pocket size what is styled the "Red Book," of 54 pages, containing extensive tables of weights per lineal foot of all sizes of rounds, squares, flats and other shapes in bar iron and steel; areas and circumferences of circles, advancing by tenths from 1-10 inch to 100 inches diameter; official classifications of extras on both steel and iron bars, weights and gauges of steel plates and sheets, and much other information of value to railway mechanical men.

* * *

Catalogue No. 3 has been issued by the Hanna Engineering Works, Chicago, and its selling organization, the Vulcan Engineering Sales Co. It contains complete information and descriptions concerning the Hanna pneumatic riveter, together with information concerning Mumford molding machines, Hanna shakers and Q. & C. metal sawing machines.

* * *

A very comprehensive catalogue has been issued by the Dobbie Foundry & Machine Co., of Niagara Falls, N. Y., 6x9 inches in size and containing 250 pages. This firm manufactures steel derricks of all descriptions, together with their fittings, car wheels and axles, hoists and hoisting engines, wall cranes, traveling cranes, winches, pile drivers and buckets.

Industrial Notes

The Canadian Car & Foundry Co., it is reported, will make extensive additions to the foundry of the Pratt & Letchworth Co., of Brantford, Ont. It is said that the business of the latter has been taken over by the Canadian Car & Foundry Co.

The Forged Steel Wheel Co., it is reported, will add a sheet mill to its plant at Sharon, Mass.

John J. Keefe, southern representative for the Independent Pneumatic Tool Co., at Atlanta, Ga., died November 20 from an attack of typhoid fever. Interment was made at Bloomington, Ill., Sunday November 24. The deceased was born in Susquehanna, Pa., forty-seven years ago and leaves a widow and one son. Mr. Keefe's entire business life was associated with the railroads, having served for a number of years in the mechanical departments of various roads until about ten years ago, when he entered the railway supply field, and continued in that line up to the time of his death. Walter A. Johnson, manager of the Atlanta, Ga., office, has been appointed to succeed Mr. Keefe. Mr. Johnson has been connected with the Independent Company's Pittsburgh office for several years, and is well equipped to take up his new duties.

Westinghouse Church Kerr & Co., have secured for their iron & steel works department, Pittsburgh, Pa., the services of Walter Rachals, who has resigned his position in charge of Julian Kennedy's engineering office. Mr. Rachals has been connected with the iron and steel business in the United States since 1895, and was chief engineer of the National Steel Company until this concern was consolidated with the Carnegie Steel Company.

The Alexander Milburn Co., of Baltimore, has just moved to its new premises at 1420-26 West Baltimore street. For some time past the firm has been operating under considerable difficulty on account of having insufficient space. Less than two years ago it increased its space materially by taking in an additional building at the former location, on Lombard street, at which time it anticipated having ample room to serve for several years, but owing to the increased requirements it was necessary to seek new quarters. The new premises were purchased in late summer and have been converted into a most modern building for factory and officers. The Milburn Company is an extensive manufacturer of various kinds of acetylene apparatus.

The tenth annual Convention of the Railway Storekeepers' Association will be held at Auditorium Hotel, Chicago, on May 19, 20 and 21, 1913.

The United States Steel Corporation will build a new bar mill at Duquesne, Pa. The plant will cost $650,000 and will have a capacity of 120,000 tons of steel per year.

W. J. Black has been appointed general manager of the Brownell Improvement Co., Chicago, and A. H. Bannister has been appointed general superintendent.

Edwin Strassburger has been elected vice-president of the Buffalo Brake Beam Co. of New York City. His headquarters will be in St. Louis, Mo.

The Crane Co. has concluded negotiations for the purchase of more than 100 acres of land at South Kedzie and Archer avenues, Chicago, to be used for a central plant, to cost about $7,000,000, and employ 6,000 men. It is proposed to bring together on one side the various separate units of the Crane Company which are now located in various parts of the city. Work on the new plant will be started early next year.

The New Castle Steel & Iron Co., it is reported, has completed negotiations for the purchase of the plant of the New Castle Forge & Bolt Co., New Castle, Pa., with a view of using the works as a nucleus for a steel car plant. The company recently was incorporated in Pennsylvania with a capital stock of $100,000. The incorporators named are W. H. Schoen, E. N. Ohl, George P. Rhodes, A. B. Berger and E. H. Brainard, of Pittsburgh.

Gove S. Taylor has been made a representative of the Magnolia Metal Co. of New York, in the Pittsburgh district. Mr. Taylor was formerly manager of the Peerless Rubber Mfg. Co.

At the annual meeting of the Pullman Co., Chicago, Le Roy Kramer was elected assistant to president, succeeding C. S. Sweet, deceased. Mr. Kramer has held this position by appointment. All the officers of the company were re-elected and the directors were re-elected, except that F. O. Lowden succeeds H. C. Hulbert, deceased. George F. Baker was made a member of the executive committee, succeeding Mr. Hulbert.

George A. Thompson, formerly with the Sellers Mfg. Co., Chicago, has become associated with the Deforest Sheet & Tin Plate Co. He will also represent the Buffalo Copper & Brass Rolling Mill.

The Streeter Supply Co., Chicago, Ill., has been incorporated in Illinois to deal in railway supplies and equipment. The incorporators are A. L. Streeter, George C. Marsh and John Hyland. Capital stock, $10,000.

Recent Railway Mechanical Patents

LOCOMOTIVE.

1,044,520—George J. Hatz, Omaha, Neb.

A draft arrangement for locomotives consisting of a drum mounted in the smoke box substantially coaxially therewith. The drum has solid heads and cylindrical walls the forward portion being perforated and a rearward portion solid. There is a vertical guide partition extending between the rear head of the drum and the tube sheet of the boiler; a vertical partition longitudinally dividing the forward portion of the interior of the drum and a partition extending across the smoke box from the tube sheet of the boiler over the top of the drum. Also an annular baffle plate extending inward from the walls of the smoke box to within a short distance of the walls of the drum and an ejector to withdraw cinders from the smoke box.

GRAIN-CAR DOOR.

1,045,313—Joseph Morris and Charles Brownlee, Keewatin, Ontario, Canada.

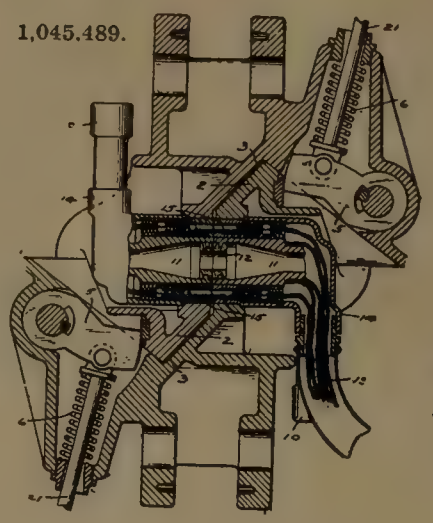
This is a door having an opening in its lower end, an angle iron carried thereby and projecting slightly beyond the lower edge thereof, and a relief door slidably and swingly mounted on said door and adapted to be engaged and held in operative position by said angle iron. There are links flexibly connected to the relief door, short crank shafts journaled in said door, and a yoke connected thereto, adapted to operate the same. The rods are flexibly connected at their opposite ends, respectively, to a crank of each of said crank shafts, and to the said links.

LOCOMOTIVE-STOKER.

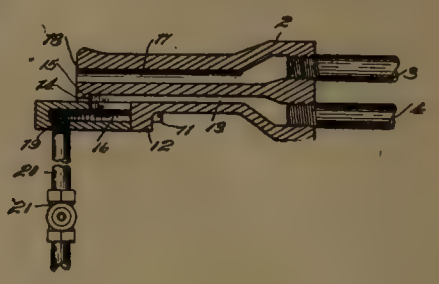
1,044,939—Frank H. Strouse, Oskaloosa, Iowa.

This is a locomotive stoker, having a vertically disposed conveyer, a number of hoppers embracing the fire box and communicating with both of its sides, a horizontal conveyer communicating with the first mentioned conveyer and said hoppers and adapted to deliver fuel to it. The fuel feeding valves are arranged adjacent the delivery ends of said hoppers, and can be opened by valves on one side of the fire box closing the valves on the other side and vice-versa. Rotary distributers are arranged to distribute the fuel within the fire box.

1,045.489.



1,045,457.



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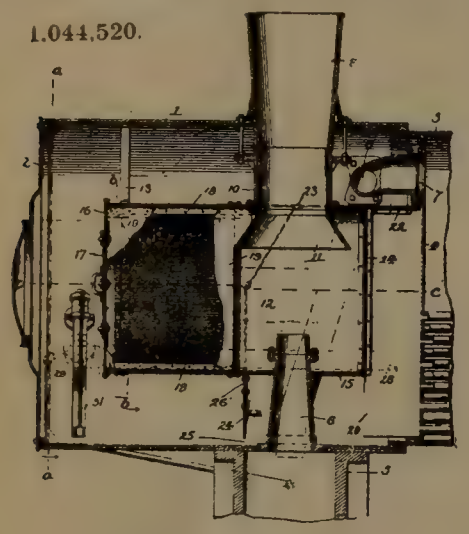

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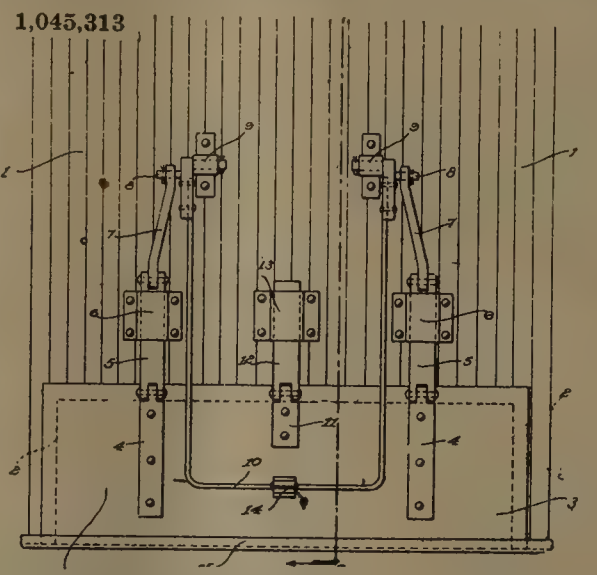
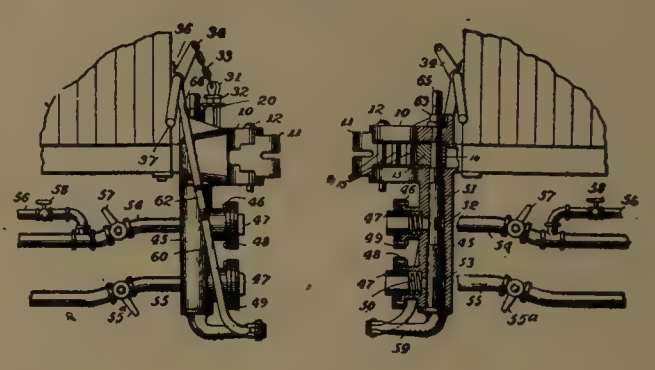


1,045,334.



TOOL-HOLDER.

1,045,512—James Carr, Syracuse, N. Y., assignor to The Henry G. Thompson & Son Company, New Haven, Conn.

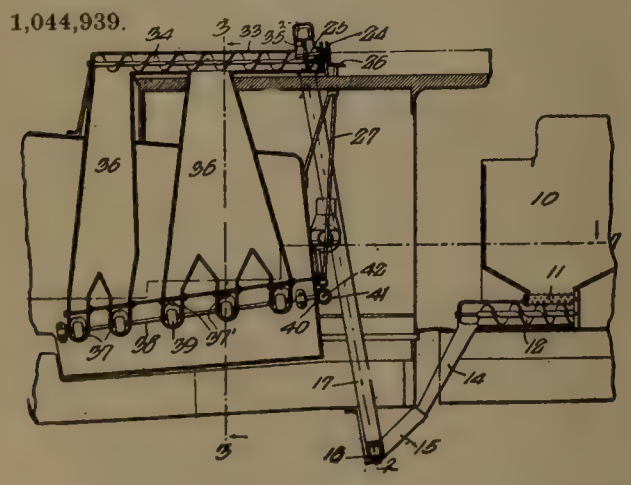
This is a tool holder comprising a tool holding head having an undercut jaw, and an opposing movable jaw also undercut. There is an auxiliary tool holder internally fitted to the appropriate tool and externally fitting the jaws. It is open on the side toward the head and has divergent inclined surfaces that co-operate with the undercut jaws tending to draw the tool against the head in the clamping action of the jaws. The auxiliary holder is adapted to yield under clamping pressure of the jaws to grip the tool within it.

OIL-BURNER.

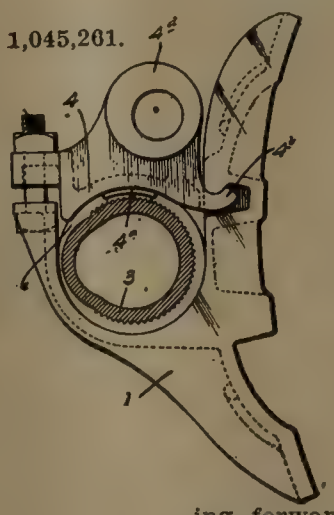
1,045,457—Edward Wright Thomas, Stockton, Cal., assignor of one-half to Charles William Yolland, Berkeley, Cal.

This oil burner comprises a body portion having a chamber with a discharge orifice, and a detachable and renewable table projecting forwardly from the body and beneath the discharge orifice. There is a steam chamber in the body, the table being chambered and communicating with the steam chamber in the body, a lip on the body recessed to form a passageway from said steam chamber in the body to the front surface of the table, and means for supplying steam to the steam chamber in the body and to the chamber in the table for heating said table.

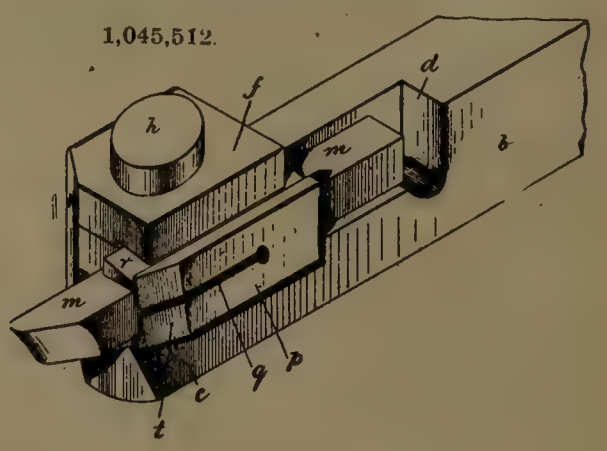
1,044,939.



1,045,261.



1,045,512.



BRAKE-HEAD.

1,045,261—Frederick R. Cornwall, St. Louis, Mo., assignor to Chicago Railway Equipment Company, Chicago, Ill.

This is a brake head provided with means whereby it may be adjustably secured to a brake beam. It has an opening in one wall of its socket of such size as to permit the introduction and removal of the brake beam through it in a vertical direction. There are also means for securing the head on the beam in adjusted position.

CAR-COUPLING.

1,045,334—Louis N. Singin, Walls, Pa.

This consists of a car coupling, and a fluid conduit with a valve in the conduit having its stem extending directly into the coupling casing. It is there connected with the movable jaw by which the valve is positively moved to both open and close the conduit.

AUTOMATIC CAR-COUPLING.

1,045,489—Harry F. Woernley, Allegheny, Pa., assignor, by mesne assignments, to Henry Herman Westinghouse, New York, N. Y.

This is an automatic coupling for cars comprising a casting having an opening through a face thereof for coupling a fluid pressure conduit, a gasket in said opening for making a tight joint, and a number of terminal contact points located in an annular form around the outer side of said gasket for connecting electrical conductors.

JUL 25 1966

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